



# ANNALES

**Anali za istrske in mediteranske študije**  
**Annali di Studi istriani e mediterranee**  
**Annals for Istrian and Mediterranean Studies**

**Series historia naturalis, 21, 2011, 2**



UNIVERZITETNA  
ZALOŽBA ANNALES

KOPER 2011

ISSN 1408-533X

UDK 5

Letnik 21, leto 2011, številka 2

**UREDNIŠKI ODBOR/  
COMITATO DI REDAZIONE/  
BOARD OF EDITORS:**

Dunja Bandelj Mavsar, Nicola Bettoso (IT), Christian Capapé (F), Darko Darovec, Dušan Devetak, Jakov Dulčić (HR), Serena Fonda Umani (IT), Andrej Gogala, Daniel Golani (IL), Mitja Kaligarič, Gregor Kovačič, Marcelo Kovačič (HR), Andrej Kranjc, Lovrenc Lipej, Alenka Malej, Patricija Mozetič, Martina Orlando Bonaca, Michael Stachowitsch (A), Tom Turk, Elena Varljen Bužan, Tone Wraber

**Glavni urednik/Redattore Capo/  
Managing Editor:**

Darko Darovec

**Odgovorni urednik naravoslovja/  
Redattore responsabile per le scienze  
naturali/Natural Science Editor:**

Lovrenc Lipej

**Urednica/Redattrice/Editor:**

Patricija Mozetič

**Lektorji/Supervisione/Language editors:**

Anja Pirih (angl./sl.)

**Prevajalci/Traduttori/Translators:**

Anja Pirih (angl./sl.), Martina Orlando-Bonaca (sl./it.)

**Oblikovalec/Progetto grafico/  
Graphic design:**

Dušan Podgornik, Lovrenc Lipej

**Prelom/Composizione/Typesetting:**

Grafis trade d.o.o.

**Tisk/Stampa/Print:**

Grafis trade d.o.o.

**Izdajatelj/Editori/Published by:**

Univerza na Primorskem, Znanstveno-raziskovalno središče Koper / *Università del Litorale, Centro di ricerche scientifiche di Capodistria* / *University of Primorska, Science and Research Centre of Koper*®, Zgodovinsko društvo za južno Primorsko/ *Società storica del Litorale*©

**Za izdajatelja/Per gli Editori/  
Publishers represented by:**

Darko Darovec, Salvator Žitko

**Sedež uredništva/  
Sede della redazione/  
Address of Editorial Board:**

Nacionalni inštitut za biologijo, Morska biološka postaja Piran / *Istituto nazionale di biologia, Stazione di biologia marina di Pirano* / *National Institute of Biology, Marine Biology Station Piran* SI-6330 Piran/Pirano, Fornače/Fornace 41, tel.: +386 5 671 2900, fax 671 2901; **e-mail:** annales@mbss.org, **internet:** <http://www.zrs.upr.si/>

Redakcija te številke je bila zaključena 15. 12. 2011.

**Sofinancirajo/Supporto finanziario/  
Financially supported by:**

Javna agencija za knjigo Republike Slovenije, Ministrstvo za šolstvo in šport Republike Slovenije, Mestna občina Koper, Občina Izola

Annales - series *historia naturalis* izhaja dvakrat letno.

Letna naročnina je 16 EUR, maloprodajna cena tega zvezka je 11 EUR.

**Naklada/Tiratura/Circulation:**

700 izvodov/copie/copies

Revija Annales series *historia naturalis* je vključena v naslednje podatkovne baze: BIOSIS-Zoological Record (UK); Aquatic Sciences and Fisheries Abstracts (ASFA)

## VSEBINA / INDICE GENERALE / CONTENTS

## ENTOMOLOGIJA

## ENTOMOLOGIA

## ENTOMOLOGY

**Dušan DEVETAK & Vesna KLOKOČOVNIK**Eugregarinorida in *Myrmeleon* and *Euroleon*:

first evidence of the gregarines

(Protozoa: Apicomplexa) in adult antlions

(Insecta: Neuroptera: Myrmeleontidae) ..... 119

*Eugregarinorida v volkcih Myrmeleon in Euroleon*:*prva najdba gregarin (Protozoa: Apicomplexa)**v odraslih volkcih (Insecta: Neuroptera:**Myrmeleontidae)***Toni KOREN, Ivana ROJKO & Boris LAUŠ**

Additions to the faunal list of scarabaeoid beetles

(Insecta, Scarabaeoidea) of the river Zrmanja

and its surroundings, Croatia ..... 125

*Dodatki k seznamu favne plojkašev (Insecta,**Scarabaeoidea) reke Zrmanje in okoliških krajev,**Hrvaška*

## SREDOZEMSKA HRUSTANČNICE

## PESCI CARTILAGINEI DEL MEDITERRANEO

## MEDITERRANEAN ELASMOBRANCHS

**Olfa EL KAMEL-MOUTALIBI, Néjia MNASRI,****Moncef BOUMAÏZA Christian REYNAUD &****Christian CAPAPÉ**Abnormalities in common torpedos, *Torpedo**torpedo* (Chondrichthyes: Torpedinidae) from

the Lagoon of Bizerte (northern Tunisia,

central Mediterranean) ..... 135

*Nepravilnosti pri navadnem električnem skatu, Torpedo**torpedo (Chondrichthyes: Torpedinidae) iz Lagune**Bizerte (severna Tunizija, osrednje Sredozemlje)***Hakan KABASAKAL, Cem DALYAN, Adem YURTSEVER**Additional records of the bigeye thresher shark *Alopias**superciliosus* (Lowe, 1839) (Chondrichthyes:

Lamniiformes: Alopiidae) from Turkish waters ..... 143

*Novi podatki o velikooki morski lisici Alopias**superciliosus (Lowe, 1839) (Chondrichthyes:**Lamniiformes: Alopiidae) v turških vodah*

## IHTIOLOGIJA

## ITTIOLOGIA

## ICHTHYOLOGY

**Laith A. JAWAD, Juma M. AL-MAMRY,****Amal M. AL-HINAI, Maryam A. AL-RASHID &****Haithem K. AL-BUSAIDI**

Preliminary study on asymmetry in morphological

characters of *Pentapirion longimanus* (Osteichthyes:

Gerridae) from the Sea of Oman ..... 151

*Predhodna študija asimetrije morfoloških znakov**pri vrsti Pentapirion longimanus (Osteichthyes:**Gerridae) iz Omanskega zaliva***Lovrenc LIPEJ & Sašo MOŠKON**On the record of the moray eel (*Muraena helena*

Linnaeus, 1758) in Slovenian coastal waters

(Gulf of Trieste, northern Adriatic) ..... 157

*O pojavljanju murene (Muraena helena**Linnaeus, 1758) v slovenskih obalnih vodah**(Tržaški zaliv, severni Jadran)***Nour El Houda KHENFECH, Moncef BOUMAÏZA,****Christian REYNAUD & Christian CAPAPÉ**

Morphological abnormalities in the annular

sea bream *Diplodus annularis* (Osteichthyes:

Sparidae) from the Lagoon of Bizerte

(northeastern Tunisia, central Mediterranean) ..... 161

*Morfološke nepravilnosti pri šparu Diplodus**annularis (Osteichthyes: Sparidae) iz Lagune Bizerte**(severovzhodna Tunizija, osrednje Sredozemlje)***Laith A. JAWAD & Juma A. AL-MAMRY**Scale deformities in rohu *Labeo rohita*

(Osteichthyes: Cyprinidae) ..... 167

*Deformacije lusk pri vrsti Labeo rohita**(Osteichthyes: Cyprinidae)*

## RECENTNE SPREMEMBE V SREDOZEMSKI

## IHTIOFAVNI

## CAMBIAMENTI RECENTI NELLA ITTIOFAUNA

## MEDITERRANEA

## RECENT CHANGES IN THE MEDITERRANEAN

## ICHTHYOFAUNA

**Sihem RAFRAFI-NOUIRA, Néjia MNASRI,  
Moncef BOUMAÏZA, Christian REYNAUD &  
Christian CAPAPÉ**

New records of the Lessepsian migrant,  
bluespotted cornetfish, *Fistularia commersonii*  
(Osteichthyes: Fistularidae) off the Tunisian coast  
(central Mediterranean) ..... 177  
*Novi podatki o pojavljanju lesepske selivke,  
modropikastega trobentača *Fistularia commersonii*  
(Osteichthyes: Fistularidae) ob tunizijski obali (osrednje  
Sredozemlje)*

FLORA  
FLORA  
FLORA

**Amelio PEZZETTA**

Prodromo della flora di Lama dei Peligni (Regione  
Abruzzo e Parco Nazionale della Majella) ..... 185  
*Prvi popis flore občine Lama dei Peligni  
(dežela Abruzzo in Nacionalni park Majella)*

DELO NAŠIH ZAVODOV IN DRUŠTEV  
ATTIVITÀ DEI NOSTRI ISTITUTI E DELLE  
NOSTRE SOCIETÀ  
ACTIVITIES BY OUR INSTITUTIONS  
AND ASSOCIATIONS

MedPAN North - 4. sestanek projektne sveta,  
Izola, 19.-21. september 2011 (**Robert Turk**) ..... 207  
Great White Tales (**Hakan Kabasakal &  
Özgür Kabasakal**) ..... 207  
Auguri Miramare (**Roberto Odorico**) ..... 209

OCENE IN POROČILA  
RECENSIONI E RELAZIONI  
REVIEWS AND REPORTS

Jakov Dulčić & Branko Dragičević: Nove ribe  
Jadranskog i Sredozemnog mora. Institut za  
oceanografiju i ribarstvo, Split & Državni zavod za  
varstvo prirode, Zagreb, 2011 (**Lovrenc Lipej**) ..... 213

Navodila avtorjem ..... 214  
*Istruzioni per gli autori* ..... 216  
*Instructions to authors* ..... 218

Kazalo k slikam na ovitku ..... 220  
*Indice delle foto di copertina* ..... 220  
*Index to pictures on the cover* ..... 220

Short scientific article  
Received: 2011-09-13

UDK [593.191+595.74]:591.557.8

## EUGREGARINORIDA IN *MYRMELEON* AND *EUROLEON*: FIRST EVIDENCE OF THE GREGARINES (PROTOZOA: APICOMPLEXA) IN ADULT ANTLIONS (INSECTA: NEUROPTERA: MYRMELEONTIDAE)

Dušan DEVETAK & Vesna KLOKOČOVNIK

Department of Biology, Faculty of Natural Sciences and Mathematics, University of Maribor, SI-2000 Maribor,  
Koroška cesta 160, Slovenia  
E-mail: dusan.devetak@guest.arnes.si

### ABSTRACT

*During study of morphology of Neuroptera septate gregarines were found in the digestive tract of adult specimens of two antlion species, Myrmeleon hyalinus and Euroleon nostras. Micrographs and morphometric data of gamonts and trophozoites indicate that they belong to the genus Gregarina. However, additional studies will be required to identify gregarines at the species level. The present paper represents the first record of gregarines from adult antlions.*

**Key words:** Gregarines, Eugregarinorida, Neuroptera, antlions, Myrmeleontidae, parasites

## EUGREGARINORIDA IN *MYRMELEON* E *EUROLEON*: PRIMA EVIDENZA DI GREGARINE (PROTOZOA: APICOMPLEXA) IN ADULTI DI FORMICALEONE (INSECTA: NEUROPTERA: MYRMELEONTIDAE)

### SINTESI

*Durante uno studio sulla morfologia di neurotteri Formicaleone, sono state trovate gregarine nel tratto digerente di individui adulti di due specie, Myrmeleon hyalinus e Euroleon nostras. Dai dati morfometrici e dalle micrografie di gamonti e trofozoiti emerge che essi appartengono al genere Gregarina. Gli autori rilevano la necessità di studi aggiuntivi al fine di identificare le gregarine a livello di specie. L'articolo rappresenta la prima segnalazione della presenza di gregarine in individui adulti di Formicaleone.*

**Parole chiave:** Gregarine, Eugregarinorida, Neuroptera, Formicaleone, Myrmeleontidae, parassiti

## INTRODUCTION

Gregarines (Eugregarinorida) are relatively large protozoan parasites in the guts and body cavities of several kinds of invertebrates, including annelids, tunicates, sipunculids and especially arthropods (Clopton, 2002; Rueckert & Leander, 2008). The anterior end is attached to the host via mucron in aseptate gregarines or epimerite in septate gregarines. Characteristic for gregarines is syzygy – the process in which two mature trophozoites pair up before the formation of a gametocyst. Life-cycle of nearly all species requires only one host. Gregarines move by gliding, bending and peristalsis (Clopton, 2002).

The majority of eugregarine species are reported from insects. The knowledge of their occurrence in insects is poor; gregarines have been reported from less than one percent of named insect species (Clopton, 2002).

The first gregarine genus recognized, *Gregarina* Dofour, 1828, was established for *Gregarina ovata* (Dofour, 1828) known as a parasite in the digestive tracts of earwigs (Dermaptera). In the period since *Gregarina* was erected the genus has grown to include more than 300 species primarily infecting coleopterans and orthopterans. As is often the case with nominate genera, *Gregarina* has become an agglomeration of taxa that includes a number of unrecognized or cryptic genera (see Clopton, 2002; Hays et al., 2004; Clopton & Hays, 2006; Clopton et al., 2008a, b).

The first record of gregarines in lacewings (Neuroptera) dates back to 1969 when Geus (1969) described *Hyalospora hemerobii* from brown lacewing *Hemerobius pini*. Later, in 1978 a new gregarine species, *Actinocephalus acanthaclisis* was described from larval antlion *Acanthaclisis baetica* originating from France (Marques & Ormières, 1978). In the present paper, gregarines from adult antlions are reported for the first time.

## MATERIAL AND METHODS

Adult antlions *Myrmeleon hyalinus hyalinus* (Olivier, 1811) and *Euroleon nostras* (Geoffroy in Fourcroy, 1785) were reared from larval stages. Larvae of *M. hyalinus hyalinus* were collected in Douz (Tunisia) and larvae of *E. nostras* were collected in Katlanovo (Macedonia). Adults were fed in captivity with apricot jam and mealworm larvae, *Tenebrio molitor*. The mealworm larvae were macerated before being consumed by the adults.

Each antlion was dissected and its intestine was examined microscopically at magnifications 100x, 200x and 400x. In total, 5 adults of *M. hyalinus hyalinus* and 3 adults of *E. nostras* were examined for gregarine presence.

Observed gregarines were measured and photographed using a Nikon E 800 Microscope with a mounted digital camera Nikon DN100, and processed with Eclipse Net version 1.16.3 software. The following standard parameters of gregarine body (in  $\mu\text{m}$ ), according to Lipa (1967) and Clopton (2004), were measured to describe the characteristics of pathogens in the investigated antlions: total length, length of protomerite, length of deutomerite, width of protomerite, and width of deutomerite.

## RESULTS

*Gregarines in Myrmeleon hyalinus hyalinus*

In the gut of one male of *M. hyalinus hyalinus* five gregarines were found. Individuals were elongated and solitary. Measurements are given in Table 1. Two morphological types were distinguished. In one gregarine type (Type A), measuring 122.9–152.9  $\mu\text{m}$  in length, protomerite had hemispherical shape and deutomerite

**Tab. 1: Measurements of gregarines in *Myrmeleon hyalinus hyalinus* (in  $\mu\text{m}$ ). Legend: TL - total length; LP - length of protomerite; WP - width of protomerite; LD - length of deutomerite; WD - width of deutomerite; WP:LP - ratio of the width of protomerite to the length of protomerite; WD:LD - ratio of the width of deutomerite to the length of deutomerite; WP:WD - ratio of the width of protomerite to the width of deutomerite; WP:TL - ratio of the width of protomerite to the total length; LP:TL - ratio of the length of protomerite to the total length.**

**Tab. 1: Meritve gregarin v volkcih vrste *Myrmeleon hyalinus hyalinus* (v  $\mu\text{m}$ ). Legenda: TL - celotna dolžina; LP - dolžina protomerita; WP - širina protomerita; LD - dolžina deutomerita; WD - širina deutomerita; WP:LP - razmerje med širino protomerita in dolžino protomerita; WD:LD - razmerje med širino deutomerita in dolžino deutomerita; WP:WD - razmerje med širino protomerita in širino deutomerita; WP:TL - razmerje med širino protomerita in celotno dolžino; LP:TL - razmerje med dolžino protomerita in celotno dolžino.**

Gregarines	Parameter									
	TL	LP	WP	LD	WD	WP:LP	WD:LD	WP:WD	WP:TL	LP:TL
Type A1	152.9	26.7	33	126.2	49.5	1.24	0.39	0.67	0.22	0.17
Type A2	128.5	24.6	25.1	103.9	42.3	1.02	0.41	0.59	0.20	0.19
Type A3	122.9	23.8	27.6	99.1	38.3	1.16	0.39	0.72	0.22	0.19
Type A4	143.8	24.4	32.3	119.4	45.5	1.32	0.38	0.71	0.22	0.17
Type B1	101.5	20.5	17.8	81	38	0.87	0.47	0.68	0.18	0.20

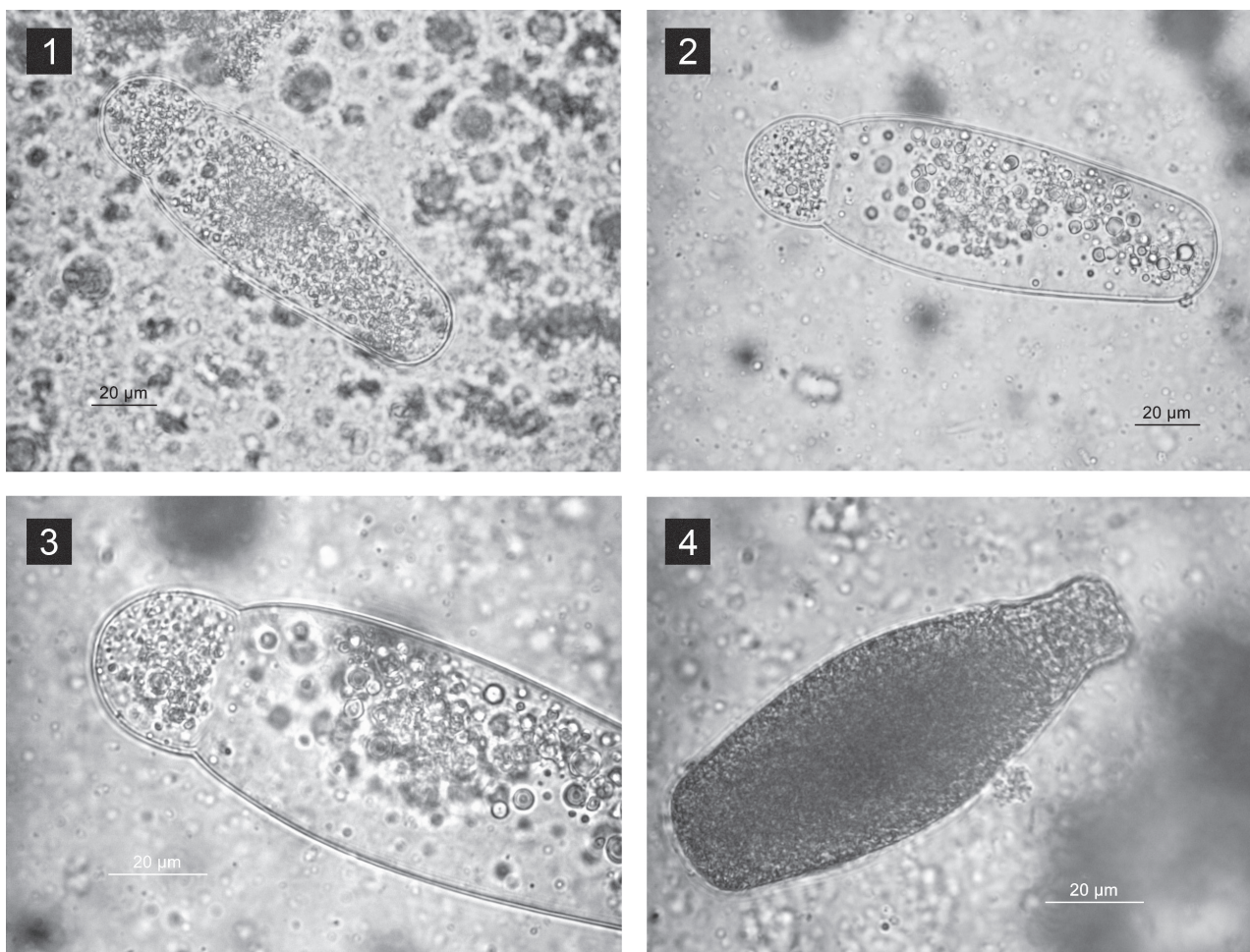


Plate 1 / Tabla 1:

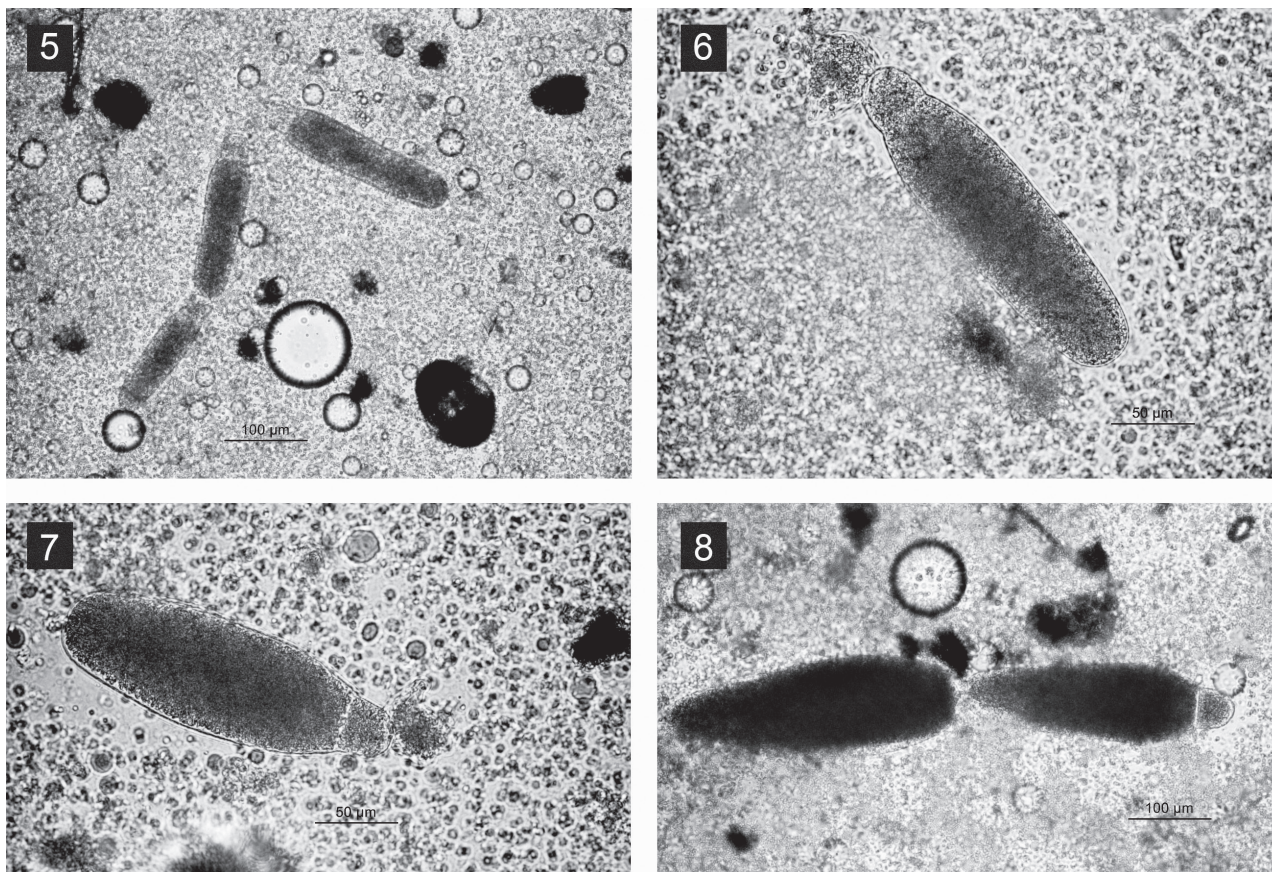
**Figs. 1-3: Gregarines of the Type A in *Myrmeleon hyalinus hyalinus*. Figs. 1, 2: Individuals from the gut lumen. Fig. 3: Detail of the protomerite. Fig. 4: An individual of the Type B in *M. hyalinus hyalinus*.**

**Sl. 1-3: Gregarine tipa A v volkcuh vrste *Myrmeleon hyalinus hyalinus*. Sl. 1, 2: Osebki iz črevesnega lumna. Sl. 3: Detajl protomerita. Sl. 4: Osebek tipa B v volkcuh vrste *M. hyalinus hyalinus*.**

**Tab. 2: Measurements of gregarines in *Euroleon nostras* (in µm). For legend see Table 1. Individuals marked with asterisk (\*) were measured in syzygium.**

**Tab. 2: Meritve gregarin v volkcih vrste *Euroleon nostras* (v µm). Za legendo glej Tabelo 1. Posamezni primerki, označeni z zvezdico (\*), so bili izmerjeni v sizigiji.**

Gregarines	Parameter									
	TL	LP	WP	LD	WD	WP:LP	WD:LD	WP:WD	WP:TL	LP:TL
1*	198	29	32.1	169	51.9	1.11	0.31	0.62	0.16	0.15
2*	160.2	24.6	34.9	135.6	46.8	1.42	0.35	0.75	0.22	0.15
3	239.4	34.6	33.3	204.8	52.8	0.96	0.26	0.63	0.14	0.14
4*	183.7	31.4	35.5	152.3	53.6	1.13	0.35	0.66	0.19	0.17
5*	151.1	24.3	28.3	126.8	42.9	1.16	0.34	0.66	0.19	0.16
6	212.5	30.4	33.8	182.1	54.5	1.11	0.30	0.62	0.16	0.14
7*	315	45.4	47.4	269.6	95.3	1.04	0.35	0.50	0.15	0.14
8*	372.1	27.2	50.3	344.9	115.1	1.85	0.33	0.44	0.14	0.07
9	201	27.9	31.3	173.1	68.3	1.12	0.39	0.46	0.16	0.14
10*	233.8	36.2	32.8	197.6	53.7	0.91	0.27	0.61	0.14	0.15



**Plate 2 / Tabla 2:**

**Figs. 5-8: Gamonts in *Euroleon nostras*. Fig. 5: A group of gregarines; syzygy is shown on the left. Figs. 6, 7: Two solitary individuals. Fig. 8: Syzygy of caudofrontal type.**

**Sl. 5-8: Gamonti v volkcú vrste *Euroleon nostras*. Sl. 5: Skupina gregarin: na levi je prikazana sizigija. Sl. 6, 7: Dva posamezna osebka. Sl. 8: Sizigija kavdofrontalnega tipa.**

was cylindrical to elongate ellipsoidal (Figs. 1-3). Constriction was noted at protomerite deutomerite septum. The other type (Type B) with 101.5 µm length was bottle-like shaped and protomerite was broadly conical (Fig. 4).

#### Gregarines in *Euroleon nostras*

One female *E. nostras* contained at least ten gregarines (Figs. 5-8). A few examples of syzygy were observed and they were of caudofrontal type (Fig. 8). Measurements are given in Table 2. Gregarines measuring 151.1–372.1 µm in length were elongate ellipsoidal to tongue-shaped with hemispherical protomerites.

#### DISCUSSION

Keys and micrographs of many European gregarine species are provided in monographs of Lipa (1967)

and Geus (1969). Marques & Ormières (1978) reported occurrence of gregarines in larval antlions. In the present study, gregarines are reported for the first time in adult antlions.

Morphometric analysis of the gregarines found in the digestive tract of adult antlions indicates that they belong to the genus *Gregarina*. According to the morphology, they resemble both gregarine species commonly occurring in *Tenebrio molitor* larvae, namely *Gregarina steini* Berndt, 1902 and *Gregarina cuneata* Stein, 1848. However, additional study will be required to identify gregarines in antlions at the species level. The adult antlions could be infected with gregarines during feeding with mealworm larvae.

#### ACKNOWLEDGEMENTS

We would like to express our thanks to Dr Paweł Sienkiewicz (University of Poznań, Poland) and Prof Dr Jerzy J. Lipa (Institute of Plant Protection, Poznań, Po-

land) for critical reading of the earlier version of the manuscript and their help and determination. This research was supported by the Slovene Ministry of Higher Edu-

cation, Science and Technology within the Biodiversity Research Programme (Grant No. P1-0078).

## EUGREGARINORIDA V VOLKCIH MYRMELEON IN EUROLEON: PRVA NAJDBA GREGARIN (PROTOZOA: APICOMPLEXA) V ODRASLIH VOLKCIH (INSECTA: NEUROPTERA: MYRMELEONTIDAE)

Dušan DEVETAK & Vesna KLOKOČOVNIK

Oddelek za biologijo, Fakulteta za naravoslovje in matematiko, Univerza v Mariboru, SI-2000 Maribor, Koroška cesta 160  
E-mail: dusan.devetak@guest.arnes.si

### POVZETEK

Med favnističnimi raziskavami mrežekrilcev smo v prebavilih odraslih volkcev dveh vrst, *Myrmeleon hyalinus* in *Euroleon nostras*, našli septatne gregarine. Na osnovi mikrofotografij gamontov in trofozoitov ter morfometričnih podatkov sklepamo, da gregarine spadajo v rod *Gregarina*. Za določitev vrste bo potrebno opraviti še več opazovanj. V prispevku so prvič zabeležene gregarine v odraslih volkcih.

**Ključne besede:** Gregarine, Eugregarinorida, Neuroptera, volkci, Myrmeleontidae, paraziti

### REFERENCES

**Clopton, R. E. (2002):** Phylum Apicomplexa Levine, 1970: Order Eugregarinorida Léger, 1900. In: Lee, J. J., G. Leedale, D. Patterson & P. C. Bradbury (eds.): Illustrated Guide to the Protozoa, 2<sup>nd</sup> Ed. Society of Protozoologists, Lawrence, Kansas, pp. 205–288.

**Clopton, R. E. (2004):** Standard nomenclature and metrics of plane shapes for use in gregarine taxonomy. *Comp. Parasitol.*, 71, 130–140.

**Clopton, R. E. & J. J. Hays (2006):** Revision of the genus *Protomagalhaensia* and description of *Protomagalhaensia wolfi* n. comb. (Apicomplexa: Eugregarinorida: Hirmocystidae) and *Leidyana haasi* n. comb. (Apicomplexa: Eugregarinorida: Leidymanidae) parasitizing the Lobster Cockroach, *Nauphoeta cinerea* (Dictyoptera: Blaberidae). *Comp. Parasitol.*, 73, 137–156.

**Clopton, R. E., T. J. Cook & J. L. Cook (2008a):** *Trichurispora wellgundis* n. g., n. sp. (Apicomplexa: Eugregarinorida: Hirmocystidae) parasitizing adult Water Scavenger Beetles, *Tropisternus collaris* (Coleoptera: Hydrophilidae) in the Texas Big Thicket. *Comp. Parasitol.*, 75, 82–91.

**Clopton, R. E., T. J. Cook & J. L. Cook (2008b):** *Gregarina tropica*, n. sp. (Apicomplexa: Eugregarinorida: Gregarinidae) parasitizing the brown-winged earwig, *Vostox brunneipennis* (Dermaptera: Labiidae), in the Texas Big Thicket. *Comp. Parasitol.*, 75, 215–227.

**Geus, A. (1969):** Sporentierchen, Sporozoa: die Gregarinida der land- und süßwasserbewohnenden Arthropoden Mitteleuropas. In: Dahl, F. (ed.): Die Tierwelt Deutschlands und der angrenzenden Meeresküste nach ihren Merkmalen und nach ihrer Lebensweise. Gustav Fischer Verlag, Jena, pp. 1–608.

**Hays, J., R. E. Clopton, D. L. Cappaert & D. R. Smitley (2004):** Revision of the genus *Stictospora* and description of *Stictospora villani*, n. sp. (Apicomplexa: Eugregarinida: Actinocephalidae) from the Japanese beetle *Popillia japonica* (Coleoptera: Scarabaeidae) in Michigan, USA. *J. Parasitol.*, 90, 1450–1456.

**Lipa, J. J. (1967):** Studies on gregarines (Gregarinomorpha) of arthropods in Poland. *Acta Protozool.*, 5, 97–179.

**Marques, A. & R. Ormières (1978):** *Actinocephalus acanthaclisis* n. sp., Eugregarine parasite des larves d'*Acanthaclisis* (Névropt. Myrmeleonidae). *Z. Parasitenkunde*, 56, 159–165.

**Rueckert, S. I. & B. S. Leander (2008):** Gregarina. Gregarines. Version 23 September 2008. <http://tolweb.org/Gregarina/124806/2008.09.23>. In: The Tree of Life Web Project (<http://tolweb.org/>)

Original scientific article  
Received: 2011-08-28

UDK 595.76:591.9(497.5)

## ADDITIONS TO THE FAUNAL LIST OF SCARABAEOID BEETLES (INSECTA, SCARABAEOIDEA) OF THE RIVER ZRMANJA AND ITS SURROUNDINGS, CROATIA

*Toni KOREN*

University of Primorska, Science and Research Centre of Koper, Institute for Biodiversity Studies, SI-6000 Koper, Garibaldijska 1, Slovenia

E-mail: koren.toni1@gmail.com

*Ivana ROJKO & Boris LAUŠ*

Biology Students Association - BIUS, HR-10000 Zagreb, Marulićev trg 20, Croatia

### ABSTRACT

*The aim of this study is to contribute to the knowledge of scarabaeoid beetle (Insecta, Scarabaeoidea) fauna of the river Zrmanja and its surroundings, Croatia. Beetles were sampled using standard beetle collecting methods, including hand collecting, pitfall traps and light traps throughout the season 2010. During that time, 52 scarabaeoid species were recorded, 37 of which are new for the area. The presence of several species was recorded for the first time either in Lika or Dalmatia. A rare cetoniid beetle, *Osmoderma barnabita* Motschulsky, 1845, was for the first time recorded for the area.*

**Key words:** Zrmanja, Coleoptera, Scarabaeoidea, biodiversity, *Osmoderma barnabita*

## CONTRIBUTO ALLA FAUNA DI COLEOTTERI SCARABAEOIDEI (INSECTA, SCARABAEOIDEA) DEL FIUME ZRMANJA E LOCALITÀ CIRCOSTANTI, CROAZIA

### SINTESI

*Lo scopo di questo studio è stato quello di contribuire alla conoscenza dei coleotteri scarabaeoidi (Insecta, Scarabaeoidea) del fiume Zrmanja e delle località circostanti, in Croazia. Gli esemplari sono stati catturati utilizzando metodi standard per la raccolta di coleotteri, compresi la raccolta a mano, le trappole trabocchetto e le trappole luminose. L'indagine è durata da maggio a ottobre del 2010. In tale periodo, 52 specie di scarabaeoidi sono state registrate, di cui 37 sono ritrovamenti nuovi per l'area. La presenza di numerose specie è stata registrata per la prima volta nella Lika e in Dalmazia. Pure la presenza di un raro coleottero cetonide, *Osmoderma barnabita* Motschulsky, 1845, è stata confermata per la prima volta nell'area.*

**Parole chiave:** Zrmanja, Coleotteri, Scarabaeoidea, diversità, *Osmoderma barnabita*

## INTRODUCTION

The knowledge about the scarabaeoids (Scarabaeoidea) in Croatia was mainly collected by Novak (1952) and Mikšić (1950, 1953, 1954, 1956, 1970). Mikšić (1958, 1962, 1965) also created some of the best determination keys for the members of this superfamily, written in Serbo-Croatian language. Unfortunately, after Mikšić hardly any papers regarding scarabaeoid beetle fauna in Croatia were published. Only a few papers dealing with one or a few species exist (Britvec, 2008; Ražov *et al.*, 2009; Harvey & Gange, 2011). So we can conclude that the knowledge about scarabaeoid beetles of Croatia remained almost the same as it was 40 years ago.

The river Zrmanja is an ecologically interesting area between two large Croatian regions, the Mediterranean Dalmatia and the mountainous Lika. This area can be very interesting to entomologists, especially because it is one of the rare locations in Croatia where traditional grazing of pastures is still fairly common, with a large number of cattle present. This is probably so due to the still visible impact of the last war, which left many villages and small towns almost completely empty, disabling the development of industry in that area. Local people thus survive by tending large amounts of cattle.

The only data about scarabaeoids of the river Zrmanja has so far been given by Novak (1952) who recorded 27 species in locations around the river Zrmanja.

The aim of this study is to report on recent data about the fauna of scarabaeoid beetles found around the river Zrmanja and its surroundings and the comparison with limited historical data, and to give some new distributional notes. The conservation status of several species is also discussed.

## MATERIAL AND METHODS

## Study area

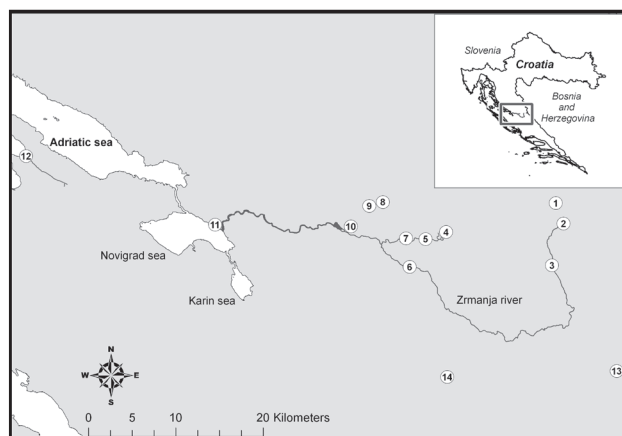
Zrmanja is a 69 km long karstic river situated on the boundary between Lika and Dalmatia (Fig. 1). The river flows from the spring at Zrmanja Vrelo, just underneath Mt. Poštak, towards the Novigrad Sea. The area of the river spring is a meeting point of mountains Velebit, Lička Plješivica and Dinara. The river Zrmanja has a southern flow from Zrmanja Vrelo all the way to Mokro polje, where the river flows across a narrow, elongated field after which it enters the canyon area (Pelivan, 2004). At Mokro polje, Zrmanja transforms into an underground river and disappears for the following 20 km. Just above Kaštel Žegarski, the river is fed with water from two smaller springheads and from this location onwards, it again flows above the ground all the way to its mouth (Matoničkin & Pavletić, 1964). Downstream of Kaštel Žegarski, the river enters another part of the canyon. Zrmanja has three tributaries, Krupa, Krnjeza and Dobranica. After Obrovac, the biggest town situated on the

banks of the river, Zrmanja enters the canyon for the last time.

Due to its specific geographical position, the river Zrmanja is considered as partly mountain, partly lowland and partly littoral river, which directly determines climatic conditions that exist along its course. From the source to the river's mouth, continental climate is gradually being influenced by the Mediterranean conditions which are characteristic for the lower parts of the river. The main annual temperature varies from 9°C (Gračac) to 14°C (Zrmanja spring). Mean annual precipitation varies between 1100 and 2100 mm/m<sup>2</sup> with an average of 1600 mm/m<sup>2</sup> (Bonacci, 1999). Vegetation patterns follow the climatic conditions while in some locations the vegetation has been substantially modified by humans, mainly referring to pastures and arable fields. This is why some areas lack natural forests which used to grow along the river. Today they are replaced by maquis and garrigue, thickets and stone grasslands. Some parts of the rivers Zrmanja and Krupa have typical wetland vegetation (Pelivan, 2004).

The main vegetation types around the river Zrmanja are mixed coastal thermophilous forests and scrubs of *Quercus pubescens* and mixed forests and scrubs of *Q. pubescens* and *Carpinus orientalis*. The main tree species in the area are *Q. pubescens*, *Quercus cerris*, *Acer monspessulanum*, *C. orientalis*, while the bushes consist mainly of *Fraxinus ornus*, *Juniperus oxycedrus*, *Coronilla emeroides*, with the evergreen elements of *Asparagus acutifolius*, *Ruscus aculeatus* and *Smilax aspera*.

In the Zrmanja area, the most common grasslands are dry and rocky pastures, created by the degradation of former oak forests and deciduous forests of hornbeam and oak, and maintained primarily by grazing. On many locations around the river Zrmanja (e.g., Vrelo Zrmanje, Kaštel Žegarski, Manastir Krupa) traditional, extensive livestock (mostly cows, sheep and goats) grazing still exists.



**Fig. 1: Location of the river Zrmanja and research localities.**

**Sl. 1: Lokacija reke Zrmanje in raziskanih lokalitet.**

### Methods

This survey started in May and lasted until October 2010, with five 20-day-long field trips. The survey was done unsystematically, during several visits in the spring and summer during one season. We mostly targeted dung species, and flower visiting scarabaeoid species, but other groups were collected as well, mainly on locations surrounding the river Zrmanja. The list of surveyed locations is given in Table 1, and shown on Figure 1.

Scarab beetles were collected using standard beetle collecting methods including manual collecting, pitfall traps and light traps (Vrezec *et al.*, 2005; Vrezec & Kapla, 2007). Members of the Cetoniidae family were mostly collected manually from flowers and trees, while other beetles were mostly picked from the ground. To collect Geotrupidae and Scarabaeidae, cow, sheep and goat dung was examined. To attract crepuscular beetles, such as some members of Scarabidae and Trogidae, a pyramid-light trap was used. In Kaštel Žegarski, ten 0.5 l plastic pitfall traps were placed, distanced 10 meters one from another. A modified standard mix for attracting beetles was used (Sorka & Finch, 2007), containing beer, vinegar, ethanol and water. For the trees dwelling species, tree trunks and tree hollows were searched (Vrezec & Kapla, 2007). All collected beetles were conserved in 70% ethanol, prepared using entomological equipment and placed into a private beetle collection (coll. T. Koren).

Due to the lack of newly published determination keys dealing with the area of Croatia, we used standard determination keys (Mikšić, 1958, 1962, 1965) to identify beetles, along with the comparison with the beetle collections of the Croatian Museum of Natural History (CHNM). To make later comparisons with this paper easier, we used the taxonomy that corresponds to the web portal Fauna Europaea (Alonso-Zarazaga & Miguel, 2011), with the exception of newly published data regarding *Osmoderma* sp. complex (Audisio *et al.*, 2009). The data analysis was conducted using historical records from the area (Novak, 1952).

### RESULTS

During one year survey around the river Zrmanja, a total of 52 scarabaeoid species belonging to 9 families were recorded (Tab. 2). The largest number of species belonged to the Scarabaeidae family (23), followed by Cetoniidae (11), Aphodiidae (4), Geotrupidae (4), Dynastidae (4), Melolonthidae (2), Lucanidae (2), Rutelidae (1) and Trogidae (1). The greatest number of species was recorded in Kaštel Žegarski (33), the Zrmanja spring (11) and Ljubački Zaljev (11).

*Cetonia aurata* (Linnaeus, 1761) was the only species recorded in all localities, *Oxythyrea funesta* (Poda, 1761) was recorded in 10 localities, *Tropinota hirta* (Poda, 1761) and *Jekelius brullei* (Jekel, 1866) in 7, while all other species were recorded in fewer localities, with more than 44% of species in only one locality.

**Tab. 1: Surveyed locations along the river Zrmanja and its near surroundings (S Croatia).**

**Tab. 1: Seznam raziskanih lokacij ob reki Zrmanji in okolici (J Hrvatska).**

	Locality name	X	Y	Altitude	UTM
1	Pond beneath Poštak mountain	5585544	4898461	320	WJ89
2	Zrmanja spring	5586431	4896100	348	WJ89
3	Zrmanja village	5585099	4891335	294	WJ89
4	Krupa spring	5573001	4895146	158	WJ79
5	Manastir Krupa	5570651	4894343	103	WJ79
6	Kaštel Zegarski, meadows near the village	5568827	4891149	56	WJ69
7	Krnjeza	5568404	4894417	62	WJ69
8	Golubići village, road to Jabukovac	5565225	4898572	363	WJ69
9	Berberi, Berberov buk waterfall	5564213	4898122	73	WJ69
10	Dobarnica, river, meadows near the river	5562104	4895769	68	WJ69
11	Zrmanja firth	5546564	4895976	27	WJ49
12	Ljubački Zaljev, close to river Jaruga	5524936	4903822	2	WK20
13	Očestovo, near the water tower	5592506	4879261	323	WJ97
14	Ervenik, pond near the macadam road	5573120	4878589	126	WJ77

**Tab. 2: Recorded Scarabaeoidea species for the river Zrmanja and its near surroundings. \* - Newly recorded species for the area (locality names are given in Table 1).****Tab. 2: Seznam vrst družine Scarabaeoidea, najdenih ob reki Zrmanji in okolici. \* - novo zabeležene vrste za območje (imena lokalitet so podana v Tabeli 1).**

	Species name and author	Locality													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
	<b>Aphodiidae</b>														
1.	<i>Colobopterus erraticus</i> (Linnaeus, 1758)*		•				•			•					
2.	<i>Coleobothrus luridus</i> (Wollaston, 1860)*						•						•		
3.	<i>Eudolus quadriguttatus</i> (Herbst, 1783)				•										
4.	<i>Nialus varians</i> (Duftschmid, 1805)*									•			•		
	<b>Scarabeidae</b>														
5.	<i>Scarabaeus typhon</i> (Fischer, 1824)						•		•						
6.	<i>Scarabaeus variolosus</i> Fabricius, 1787				•	•	•			•					
7.	<i>Gymnopleurus mopsus</i> (Pallas, 1781)*						•								
8.	<i>Gymnopleurus geoffroyi</i> (Fuessly, 1775)*								•						
9.	<i>Sisyphus schaefferi</i> (Linnaeus, 1758)								•						
10.	<i>Copris hispanus</i> (Linnaeus, 1764)*						•	•		•			•		
11.	<i>Copris lunaris</i> (Linnaeus, 1758)*						•			•					
12.	<i>Bubas bison</i> (Linnaeus, 1767)*						•		•	•					
13.	<i>Euoniticellus fulvus</i> (Goeze, 1777)						•								
14.	<i>Caccobius schreberi</i> (Linnaeus, 1758)						•								
15.	<i>Euonthophagus amyntas</i> (Olivier, 1789)								•						
16.	<i>Onthophagus taurus</i> (Schreber, 1959)						•			•					
17.	<i>Onthophagus illyricus</i> (Scopoli, 1763)*						•	•		•					
18.	<i>Onthophagus ovatus</i> (Linnaeus, 1767)*						•								
19.	<i>Onthophagus grossepunctatus</i> (Reitter, 1905)*						•								
20.	<i>Onthophagus ruficapillus</i> (Brullé, 1832)*						•								
21.	<i>Onthophagus furcatus</i> (Fabricius, 1781)						•								
22.	<i>Onthophagus opacicollis</i> (Reitter, 1893)*						•								
23.	<i>Onthophagus coenobita</i> (Herbst, 1783)*													•	
24.	<i>Onthophagus lemur</i> (Fabricius, 1781)						•	•	•						
25.	<i>Onthophagus vacca</i> (Linnaeus, 1767)						•	•		•					
26.	<i>Onthophagus nuchicornis</i> (Linnaeus, 1758)*						•								
27.	<i>Onthophagus lucidus</i> (Sturm, 1800)*														
	<b>Geotrupidae</b>														
28.	<i>Geotrupes mutator</i> (Marsham, 1802)*		•				•								
29.	<i>Anoplotrupes stercorosus</i> (Scriba, 1791)*			•											
30.	<i>Trypocopris vernalis</i> (Linnaeus, 1758)*								•						
31.	<i>Jekelius brullei</i> (Jekel, 1866)		•	•	•	•	•	•	•				•		
	<b>Melolonthidae</b>														
32.	<i>Melolontha melolontha</i> (Linnaeus, 1758)*		•				•								
33.	<i>Haplidia transversa</i> (Fabricius, 1801)*											•	•		
	<b>Rutelidae</b>														
34.	<i>Anisoplia agricola</i> (Poda, 1761)	•	•												
	<b>Dynastidae</b>														
35.	<i>Pentodon idiota</i> (Herbst, 1789)*												•		
36.	<i>Pentodon bidens</i> (Villers, 1789)*			•			•	•	•				•		•
37.	<i>Phyllognathus excavatus</i> (Forster, 1771)*		•				•								
38.	<i>Oryctes nasicornis</i> (Linnaeus, 1758)		•										•		
	<b>Cetoniidae</b>														
39.	<i>Valgus hemipterus</i> (Linnaeus, 1758)		•	•	•		•								

40.	<i>Osmoderma barnabita</i> Motschulsky, 1845 *		•												
41.	<i>Trichius fasciatus</i> (Linnaeus, 1758)*									•					
42.	<i>Trichius sexualis</i> (Bedel, 1906)*						•								
43.	<i>Tropinota squalida</i> (Scopoli, 1783)*		•												
44.	<i>Tropinota hirta</i> (Poda, 1761)*	•	•			•	•						•	•	•
45.	<i>Oxythyrea funesta</i> (Pod, 1761)*	•	•	•	•		•			•	•	•	•	•	•
46.	<i>Cetonia aurata</i> (Linnaeus, 1761)*	•	•	•	•	•	•	•	•	•	•	•	•	•	•
47.	<i>Protaetia aeruginosa</i> (Linnaeus, 1767)*						•								
48.	<i>Protaetia cuprea</i> (Fabricius, 1775)*														•
49.	<i>Protaetia angustata</i> (Germar, 1817)*						•								
	<b>Lucanidae</b>														
50.	<i>Dorcus parallelipedus</i> (Linnaeus, 1758)*		•	•	•	•	•								
51.	<i>Lucanus cervus</i> (Linnaeus, 1758)*		•	•					•						
	<b>Trogidae</b>														
52.	<i>Trox hispidus</i> Pontoppidan, 1763*	•			•	•									
	<b>No. species</b>	5	15	8	8	6	33	7	11	10	3	3	11	4	5

## DISCUSSION

For the area around the river Zrmanja, Novak (1952) mentions 27 species of scarabaeoid beetles, mostly belonging to the Scarabaeidae and Aphodiidae families. During this survey, we recorded a total of 52 scarabaeoid beetles species, 37 of which are new for this area (Tab. 2). The largest amount of species that Novak (1952) recorded belonged to the Aphodiidae family (13), while we recorded only 4 species from this family. However, we did not confirm the presence of 12 previously recorded species: *Acanthobodilus immundus* (Creutzer, 1799), *Amidorus cribrarius* (Brulle, 1832), *Agrilinus constans* (Duftschmid, 1805), *Bodilus ictericus* (Laicharting, 1781) (= *Aphodius nitidulus* Fabricius, 1792), *Esymus merdarius* (Fabricius, 1775), *Euorodalus coenosus* (Panzer, 1798), *Labarrus lividus* (Olivier, 1789), *Melinopterus consputus* (Creutzer, 1799), *Melinopterus prodromus* (Brahm, 1790), *Nimbus obliterated* (Panzer, 1823), *Pleurophorus caesus* (Creutzer, 1796) and *Sigorus porcus* (Fabricius, 1792). In addition to this, from the Scarabaeidae family we did not record *Onthophagus fracticornis* (Preyssler, 1790), which was previously recorded by Novak (1952). All other recorded scarabaeoid species were confirmed during this survey. Our data increase the number of scarabaeoid beetles known from the area of the river Zrmanja to 68 species, which is still moderately low in comparison to some better researched areas, for example in Slovenia (Brelj *et al.*, 2010).

For some species, their known range of occurrence in Croatia has been expanded. According to Mikšić (1965), *Onthophagus nuchicornis* (Linnaeus, 1758) was recorded at Kaštel Žegarski, and this is the first record in the Mediterranean part of Croatia. The same applies for *Melolontha melolontha* (Linnaeus, 1758), recorded in a few locations around the river Zrmanja and *Trichius fasciatus* (Linné, 1758), recorded on the shores of the river Dobranica.

We recorded all species from the Dynastidae family previously mentioned by Mikšić (1965) for the territory of Croatia, including the interesting finding of *Phyllognathus excavatus* (Forster, 1771). This Mediterranean species was previously recorded in southern Istria, Kvarner and Dalmatia (Mikšić, 1965). During this survey, it was recorded at the Zrmanja spring, and it represents the first record for Lika.

Faunistically the most important species is *Osmoderma barnabita* Motschulsky, 1845. Recently, it has been proven to be a separate species, genetically different from *Osmoderma eremita* (Scopoli, 1763) (Audisio *et al.*, 2009), and it is treated here as such. *O. eremita* complex (including *O. barnabita*) is listed as Near Threatened in the IUCN (2011), and also in the Habitat Directive Annexes II and IV (European Commission, 1992). *O. barnabita* has a broad range in Europe, but it is rare, due to the fact that each hollow tree sustains a local population with limited connections to the populations in the surrounding trees, resulting in the metapopulation structure of the population (Ranius & Hedin, 2001). In Croatia, only 31 records between 1892 and 2000 exist (Ranius *et al.*, 2005). This species was found on a willow tree close to the Zrmanja spring. It was collected on July 11<sup>th</sup> at dusk, which is unusual for this predominantly daytime active species.

On the nearby willow trees, a large number of tree hollows were seen and investigated, but no further *O. barnabita* were recorded. This finding, along with our observations of a large number of tree hollows, suggests that the area around the Zrmanja spring is still a good habitat for this endangered species.

Another recorded species with a special conservation status is *Lucanus cervus* (Linnaeus, 1758). In many countries, where it is present, it has an endangered or protected status and has been included in Annex II of the EC Habitats Directive, together with the status of near threatened in 2010 across Europe according to the International Union for Conservation of Nature (IUCN,

2011). As it seems, this species is expanding its areal in Europe, with the exception of Slovakia and Croatia (Harvey & Gange, 2011). Its distribution in Croatia is poorly known in comparison with the nearby Slovenia (Breljih *et al.*, 2010), but still much better in comparison with Bosnia and Herzegovina or Serbia (Harvey & Gange, 2011). In the Zrmanja area, it was recorded on three locations, and was common on each of them.

As previously stated, no scarabaeoid beetles surveys were carried out for some time, which makes it difficult to compare our data with any other area in Croatia. But even for itself, the number of 52 recorded species represents more than 25% scarabaeoid fauna of Croatia (Mikšić, 1958, 1962, 1965). As this survey was done sporadically, no significant comparisons between different locations on the river Zrmanja can be done. On two areas we recorded the largest number of scarabaeoid beetles: the Zrmanja spring (15) and Kaštel Žegarski (33). This can probably be assigned to the high number

of present cattle, as well as fairly natural habitats with many different habitats.

Conservation status of most scarabaeoid species in Croatia is unknown. This can be assigned to the lack of continuous research on beetles in Croatia, as well as to no comprehensive papers dealing with this group published in almost 40 years. Scarabaeoid beetle communities, especially dung beetles are very fragile because they are influenced by complex biotic and abiotic interactions between many environmental factors such as resource availability, vegetation structure, the use of pesticides (Hutton & Giller, 2003), elevation, exposure (Jay-Robert *et al.*, 2008) and herbivorous animal presence and diversity (Carpaneto *et al.*, 2005) and as such are in need of conservation concern. This is the reason why more systematic, as well as unsystematic, surveys of different parts of Croatia are needed, to evaluate the conservation status of scarabaeoid species and to determine eventual conservation strategies for the future.

## DODATKI K SEZNAMU FAVNE PLOJKAŠEV (INSECTA, SCARABAEOIDEA) REKE ZRMANJE IN OKOLIŠKIH KRAJEV, HRVAŠKA

Toni KOREN

Univerza na Primorskem, Znanstveno-raziskovalno središče, Inštitut za biodiverzitete študije, SI-6000 Koper, Garibaldijska 1  
E-mail: koren.toni1@gmail.com

Ivana ROJKO &amp; Boris LAUŠ

Biology Students Association - BIUS, HR-10000 Zagreb, Marulićev trg 20, Hrvatska

## POVZETEK

*Cilj te raziskave je bil doprinos k popisu favne scarabeoidnih hroščev (plojkaši ali pahljačniki) (Insecta, Scarabaeoidea) iz okolice reke Zrmanje na Hrvatskem. Hrošči so bili vzorčeni z uporabo standardnih metod za lov hroščev, in sicer z ročnim zbiranjem, uporabo pasti in svetlobnih vab v sezoni 2010. Potrjena je bila prisotnost 52 vrst, od katerih je bilo kar 37 vrst prvič zabeleženih na raziskovanem območju. Nekatere teh vrst so prvič opažene tudi na območju Dalmacije in Like, na tem območju pa je bil prvič najden tudi redek puščavnik (Osmoderma barnabita Motschulsky, 1845).*

**Ključne besede:** Zrmanja, Coleoptera, Scarabaeoidea, biodiverziteta, *Osmoderma barnabita*

## REFERENCES

- Alonso-Zarazaga, M. A. (2011):** Coleoptera, Scarabaeoidea. Fauna Europaea version 2.4. www.faunaeur.org (Accessed 15.8.2011)
- Audisio, P., H. Brustel, G. M. Carpaneto, G. Coletti, E. Mancini, M. Trizzino, G. Antonini & A. De Biase (2009):** Data on molecular taxonomy and genetic diversification of the European Hermit beetles, a species complex of endangered insects (Coleoptera: Scarabaeidae, Cetoniinae, *Osmoderma*). J. Zool. Syst. Evol. Res., 47(1), 88-95.
- Bonacci, O. (1999):** Water circulation in karst and determination of catchment areas: example of the River Zrmanja. Hydrol. Sci., 44(3), 373-386.
- Brelj, S., A. Kajzer & A. Pirnat (2010):** Gradivo za favno hroščev (Coleoptera) Slovenije = Material for the Beetle Fauna (Coleoptera) of Slovenia. 4. prispevek/4<sup>th</sup> contribution: Polyphaga: Scarabaeoidea (=Lamellicornia). Scopolia, 70, 1-386.
- Britvec, B. (2008):** *Scarabaeus sacer* L., 1758 (Scarabaeidae, Col.) from deity to reality. Entomol. Croat., 12(1), 83-102.
- Carpaneto, G. M., A. Mazziotta & E. Piattella (2005):** Changes in food resources and conservation of scarab beetles: from sheep to dog dung in a green urban area of Rome (Coleoptera, Scarabaeoidea). Biol. Conserv., 123, 547-556.
- European Commission (1992):** Council Directive 92/43/EEC of 21 May 1992 on the Conservation of natural habitats and of wild fauna and flora (OJ L206, 22.7.1992, p. 7), last amended 23.09.2003 (L236, pp. 33), Strasbourg.
- Harvey, D. J. & A. C. Gange (2011):** The stag beetle: a collaborative conservation study across Europe. Insect Conserv. Diversity, 4, 23-38.
- Hutton, S. A. & P. S. Giller (2003):** The effects of the intensification of agriculture on northern temperate dung beetle communities. J. Appl. Ecol., 40, 994-1007.
- IUCN (2011): Red List of Threatened Species. www.iucnredlist.org (Accessed: 21.12.2011)
- Jay-Robert, P., J. P. Lumaret & J. D. Lebreton (2008):** Spatial and temporal variation of mountain dung beetle assemblages and their relationships with environmental factors (Aphodiinae: Geotrupinae: Scarabaeinae). Ann. Entomol. Soc. Am., 101, 58-69.
- Matonićkin, I. & Z. Pavletić (1964):** Faktori razvoja biocenoza u slatkovodnom dijelu rijeke Zrmanje i njena pritoka Kupe. Krš Jugoslavije, 4, 47-63.
- Mikšić, R. (1950):** Beitrag zur Kenntnis der Scarabaeiden der Herzegovina. Godišnjak Biološkog instituta u Sarajevu, Sarajevo, 3, 219-224.
- Mikšić, R. (1953):** Fauna insectorum Balcanica - Scarabaeidae. Narodna štamparija Sarajevo, pp. 49-281.
- Mikšić, R. (1954):** Beitrag zur varietas der *Cetonia aurata* L. in Jugoslavien. Glasnik Prirodnačkog muzeja srpske zemlje, 457-485, b5-6.
- Mikšić, R. (1956):** Zweiter Nachtrag zur Fauna Insectorum Balcanica - Scarabaeidae. Acta Musei Macedonici scientiarum naturalium, IV, 7-9, (38-40), 97-130.
- Mikšić, R. (1958):** Scarabaeidae Jugoslawien. Naučno društvo Bosne i Hercegovine – Djela, 6(2), 150 p.
- Mikšić, R. (1962):** Scarabaeidae Jugoslawien II. Srpska akademija nauka i umetnosti, Odeljenje prirodno-matematičkih nauka, Beograd, posebna izdanja, 28, 199 p.

**Mikšić, R. (1965):** Scarabaeidae of Yugoslavia III. Naučno društvo Bosne i Hercegovine – Djela, 25(6), 210-215.

**Mikšić, R. (1970):** Katalog der Lamellicornia Jugoslaviens. Institut za šumarstvo, Sarajevo, posebno izdanje, 57 p.

**Novak, P. (1952):** Kornjaši Jadranskog primorja (Coleoptera). JAZU, Zagreb, 521 p.

**Pelivan, A. (2004):** Zrmanja, Krka, Cetina i njihovi pritoci. Ekološki glasnik, Donja Lomnica, 239 p.

**Ranius, T. & J. Hedin, 2001.** The dispersal rate of a beetle, *Osmoderma eremita*, living in tree hollows. Oecologia, 126, 363–370.

**Ranius, T., L. O. Aguado, K. Antonsson, P. Audisio, A. Ballerio, G. M. Carpaneto, K. Chobot, B. Gjurašin, O. Hanssen, H. Huijbregts, F. Lakatos, O. Martin, Z. Neculiseanu, N. B. Nikitsky, W. Paill, A. Pirnat, V. Rizun, A. Ruicănescu, J. Stegner, I. Süda, P. Szwalko, V. Tamutis, D. Telnov, V. Tsinkevich, V. Versteirt, V. Vignon, M. Vögeli & P. Zach (2005):** *Osmoderma eremita* (Coleoptera, Scarabaeidae, Cetoniinae) in Europe. Anim. Biodiversity Conserv., 28(1), 1-44.

**Ražov, J., B. Barić & M. Dutto (2009):** Fauna of the cetoniid beetles (Coleoptera, Cetonidae) and their damages on peach fruits in orchards of northern Dalmatia. Entomol. Croat., 13(2), 7-20.

**Sroka, K. & O.-D. Finch (2006):** Ground beetle diversity in ancient woodland remnants in north-western Germany (Coleoptera, Carabidae). J. Insect Conserv., 4, 335-350.

**Vrezec, A. & A. Kapla (2007):** Kvantitativno vzorčenje hroščev (Coleoptera) v Sloveniji: referenčna študija. Acta Entomol. Slov., 15(2), 131-160.

**Vrezec, A., A. Kapla, A. Pirnat & Š. Ambrožič (2005):** Primerjava številčnosti govnačev (Coleoptera: Scarabaeoidea: Geotrupidae) v Sloveniji: uporaba popisne metode za hrošče z zemeljskimi pastmi na širšem območju. Acta Entomol. Slov., 13(2), 145-164.

Original scientific article  
Received: 2011-09-20

UDK 591.159:597.317.5(262.26)

## ABNORMALITIES IN COMMON TORPEDOS, *TORPEDO TORPEDO* (CHONDRICHTHYES: TORPEDINIDAE) FROM THE LAGOON OF BIZERTE (NORTHERN TUNISIA, CENTRAL MEDITERRANEAN)

*Olfa EL KAMEL-MOUTALIBI, Néjia MNASRI & Moncef BOUMAÏZA*

Laboratoire d'Hydrobiologie Littorale et Limnique, Université du 07 novembre à Carthage, Faculté des Sciences, Zarzouna, 7021  
Bizerte, Tunisia

*Christian REYNAUD & Christian CAPAPÉ*

Laboratoire interdisciplinaire de Recherche sur la Didactique, l'Éducation et la Formation, E. A. 3749, case 77, Université Montpellier  
II, Sciences et Techniques du Languedoc, 34095 Montpellier cedex 5, France  
E-mail: capape@univ-montp2.fr

### ABSTRACT

*The authors report on the capture of two abnormal specimens of common torpedo *Torpedo torpedo* Linnaeus 1758 in the Lagoon of Bizerte, northeastern Tunisia. Both specimens, one a juvenile male and the other a juvenile female, presented the pectoral fin non adherent to the head and an incomplete pelvic fin. The specimens are described and their atypical characteristics commented and discussed.*

**Key words:** Chondrichthyes, *Torpedo torpedo*, abnormalities, Lagoon of Bizerte, northern Tunisia

## ANORMALITÀ IN TORPEDINE OCCHIUTA, *TORPEDO TORPEDO* (CHONDRICHTHYES: TORPEDINIDAE), NELLA LAGUNA DI BIZERTE (TUNISIA SETTENTRIONALE, MEDITERRANEO CENTRALE)

### SINTESI

*Gli autori segnalano la cattura di due individui anormali di torpedine occhiuta, *Torpedo torpedo* Linnaeus 1758, nella Laguna di Bizerte, Tunisia settentrionale. Entrambi gli esemplari, un giovane maschio e una giovane femmina, presentavano pinne pettorali non aderenti alla testa e pinne pelviche (ventrali) incomplete. Nell'articolo i due esemplari vengono descritti e vengono commentate e discusse le loro caratteristiche atipiche.*

**Parole chiave:** Chondrichthyes, *Torpedo torpedo*, anormalità, Laguna di Bizerte, Tunisia settentrionale

## INTRODUCTION

*Torpedo torpedo* is known in the eastern Atlantic from the Bay of Biscay (Quéro *et al.*, 2003) to Portugal (Albuquerque, 1954-1956), and south of the Strait of Gibraltar, from off Morocco (Lloris & Rucabado, 1998) to the waters of South Africa (Smith & Heemstra, 1986).

*T. torpedo* occurs throughout the Mediterranean Sea, but appears to be more frequently caught in southern areas (Capapé, 1989), especially off the Maghreb coast (Capapé, 1989; Bradai *et al.*, 2004). Additionally, the common torpedo was also recorded in Tunisian brackish areas such as the Bahiret El Biban (Capapé *et al.*, 2004), Tunis Southern Lagoon (Mejri *et al.*, 2004) and especially in the Lagoon of Bizerte, where a sustainable population developed and reproduced (Ben Brahim & Capapé, 1997; Ben Brahim *et al.*, 1998; El Kamel *et al.*, 2009a, b).

Investigations were conducted between 1995 and 2000 in the Lagoon of Bizerte, and of 863 specimens collected during this period two were abnormal (Ben Brahim & Capapé, 1997; Ben Brahim *et al.*, 1998). Similar investigations started again in 2006 and are still in progress (El Kamel *et al.*, 2009a, b; Mnasri *et al.*, 2010); during this time, an abnormal specimen was collected (El Kamel *et al.*, 2009a) and two abnormal embryos were found in a pregnant female (Mnasri *et al.*, 2010).

The aim of this paper is to present and describe these new cases of abnormality recorded in the Lagoon of Bizerte and to comment on atypical characteristics found in torpedinid species.

## MATERIAL AND METHODS

Two abnormal specimens were found on 2 October 2010 and 5 October 2010, respectively, and both were caught by gill-nets having 26 mm mesh size, at depth not exceeding 10 m, on sandy bottom, by 37°12'06.76" N and 9°54'13.86" E (Figs. 1, 2).

Fresh specimens were identified soon after capture following Quignard & Capapé (1974), Capapé & Desoutter (1981) and Mejri *et al.* (2004), measured to the nearest millimetre and weighed to the nearest decigram following Mejri *et al.* (2004). Morphometric measurements, meristic counts and total body mass recorded in both abnormal specimens and 4 normal specimens of similar size class are presented in Table 1. The latter specimens were included in order to compare percents of total length, carried out for each measurement, between abnormal and normal specimens.

All specimens from Table 1 were preserved in 10% buffered formalin and deposited in the Ichthyologi-

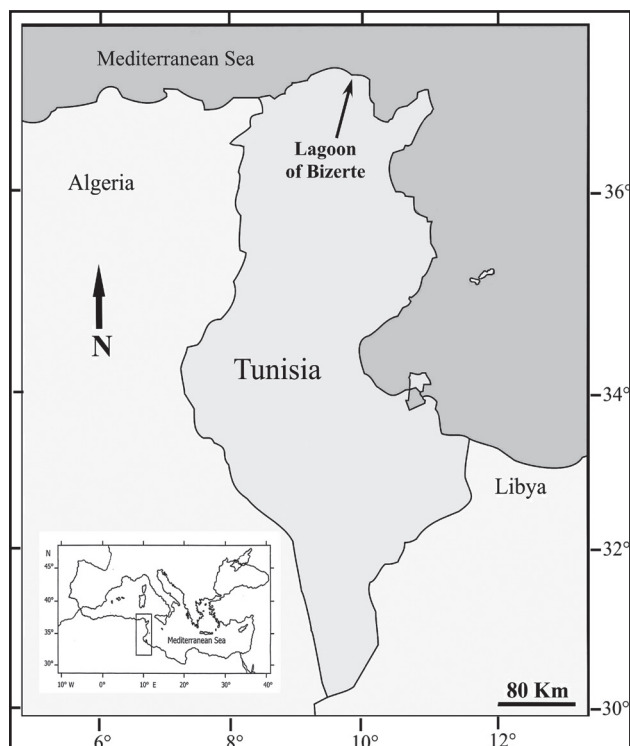


Fig. 1: Map of the Mediterranean showing the Tunisian coast and pointing out the Lagoon of Bizerte.

Sl. 1: Zemljevid Sredozemlja z obalo Tunizije in označeno Laguno Bizerte.

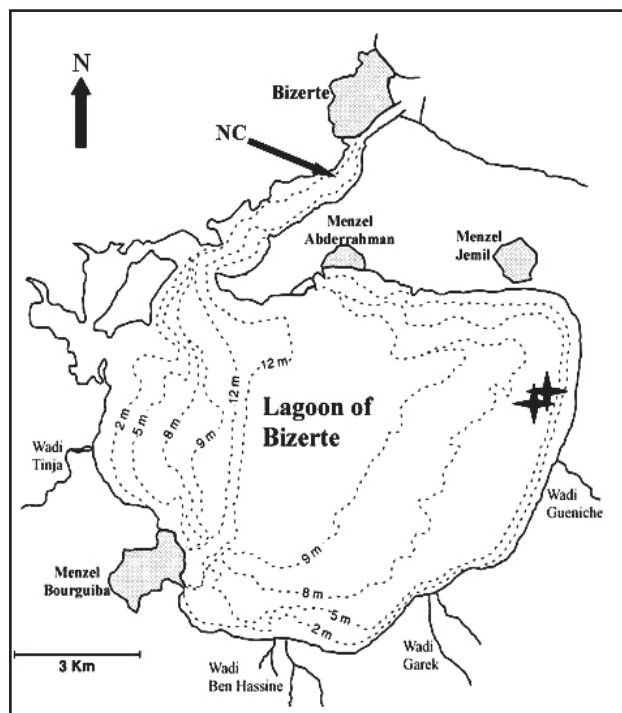


Fig. 2: Map of the Lagoon of Bizerte showing the capture site (black stars) of the abnormal torpedos (FSB T-torp.08 and T-torp.09).

Sl. 2: Zemljevid Lagune Bizerte z označenima mestoma ulova (črni zvezdi) abnormalnih primerkov električnega skata (FSB T-torp.08 in T-torp.09).

cal Collection of the Faculté des Sciences of Bizerte (Tunisia). The two abnormal specimens received the catalogue numbers: FSB T.-torp 08 and FSB T.-torp 09,

respectively, while the 4 normal specimens were catalogued from FSB T.-torp 10 to FSB T.-torp 13.

**Tab. 1: Morphometric measurements and meristic counts recorded in the abnormal common torpedos (FSB T.-torp.08 and FSB T.-torp.09), and 4 normal common torpedos (FSB T.-torp.10 to FSB T.-torp.13).**

**Tab. 1: Morfometrični in meristični podatki za abnormalna primerka (FSB T.-torp.08 in FSB T.-torp.09) in 4 normalne primerke navadnega električnega skata (FSB T.-torp.10 do FSB T.-torp.13).**

References	FSB T.-torp.08		FSB T.-torp.09		FSB T.-torp.10		FSB T.-torp.11		FSB T.-torp.12		FSB T.-torp.13	
Sex	M		F		F		M		F		M	
Condition	abnormal		abnormal		normal		normal		normal		normal	
Total mass (g)	259.8		47.40		254.30		226.90		63.4		50	
Morphometric measurements	mm	% of TL	mm	% of TL	mm	% of TL	mm	% of TL	mm	% of TL	mm	% of TL
Total length	260.0	100.0	150.4	100.0	260.0	100.0	260.0	100.0	156.4	100.0	149	100.0
Disk-length	132.0	50.8	72.3	48.1	127.0	48.8	130.0	50.0	79	50.5	80	53.7
Disk-width	160.0	61.5	89.9	59.7	156.0	60.0	155.0	59.6	93.3	59.7	100	67.1
Disk-depth	25.1	9.6	13.7	9.1	22.0	8.5	24.0	9.2	10.9	7.0	11.3	7.6
Eyeball length	6.5	2.5	4.4	2.9	6.9	2.7	6.4	2.5	5.4	3.5	4.8	3.2
Cornea	3.9	1.5	2.2	1.4	3.4	1.3	3.0	1.2	2.2	1.4	2.8	1.9
Pre-orbital length	16.3	6.3	9.9	6.6	17.6	6.8	17.4	6.7	10.5	6.7	10.9	7.3
Inter-orbital width	14.4	5.5	7.1	4.7	11.5	4.4	13.4	5.2	7.3	4.7	8.3	5.6
Nasal curtain	15.3	5.9	8.7	5.8	14.5	5.6	14.7	5.7	7.8	5.0	8.4	5.6
Spiracle diameter	4.8	1.8	3.6	2.4	4.6	1.8	4.5	1.7	3	1.9	2.8	1.9
Inter-nasal width	12.9	5.0	7.0	4.6	11.5	4.4	11.2	4.3	6.3	4.0	6.1	4.1
Space between eye and spiracle	6.8	2.6	3.6	2.4	5.6	2.2	4.8	1.8	3.8	2.4	3	2.0
Inter-spiracular width	13.3	5.1	7.5	5.0	10.8	4.2	11.6	4.5	8.7	5.6	7.8	5.2
Pre-oral length	21.1	8.1	11.5	7.6	13.9	5.3	14.3	5.5	7.8	5.0	13	8.7
Mouth width	15.2	5.8	10.6	7.0	16.2	6.2	17.6	6.8	11.3	7.2	8.9	6.0
First gill slit	5.5	2.1	2.5	1.7	7.6	2.9	6.4	2.5	3.4	2.2	3	2.0
Second gill slit	5.3	2.0	2.8	1.9	6.7	2.6	6.9	2.7	3.6	2.3	3.6	2.4
Third gill slit	5.7	2.2	3.1	2.1	7.0	2.7	8.1	3.1	3.6	2.3	3.6	2.4
Fourth gill slit	6.7	2.6	3.0	2.0	6.9	2.7	7.2	2.8	3.9	2.5	3.7	2.5
Fifth gill slit	6.0	2.3	2.3	1.5	4.4	1.7	5.6	2.2	3.1	2.0	3.3	2.2
Width between first gill slit	38.6	14.8	21.4	14.2	35.3	13.6	36.5	14.0	24	15.3	20.9	14.0
Width between fifth gill slit	36.8	14.2	20.1	13.3	34.1	13.1	33.2	12.8	23.3	14.9	19.9	13.4
Snout tip to eye	22.0	8.5	11.4	7.6	21.2	8.2	21.9	8.4	12.8	8.2	12.5	8.4
Snout tip to mouth	26.3	10.1	13.6	9.0	23.0	8.8	25.0	9.6	14	9.0	12.7	8.5
Snout tip to first gill slit	49.3	19.0	30.2	20.1	53.0	20.4	54.0	20.8	32.5	20.8	29	19.5
Snout tip to fifth gill slit	74.5	28.6	43.4	28.9	83.0	31.9	82.0	31.5	48.8	31.2	45.4	30.5
Snout tip pelvic fin	120.8	46.5	72.7	48.3	132.0	50.8	127.0	48.8	69.7	44.6	70.6	47.4
Snout tip to vent	136.9	52.6	80.0	53.2	145.0	55.8	143.0	55.0	82.6	52.8	78.6	52.8

Pectoral fin anterior margin	67.8	26.1	39.8	26.4	56.0	21.5	49.2	18.9	44.2	28.3	35.7	24.0
Pectoral fin posterior margin	89.3	34.4	48.8	32.4	88.7	34.1	87.6	33.7	49	31.3	48.2	32.3
Pectoral fin inner margin	10.2	3.9	6.3	4.2	8.1	3.1	8.2	3.2	4.5	2.9	6	4.0
Pelvic fin anterior margin	31.1	12.0	17.1	11.4	27.6	10.6	28.4	10.9	20.2	12.9	14.4	9.7
Pelvic fin posterior margin	46.6	17.9	26.3	17.5	46.7	18.0	33.7	13.0	26.8	17.1	25.7	17.2
Pelvic fin inner margin	7.9	3.0	3.9	2.6	7.9	3.0	3.7	1.4	7	4.5	6	4.0
Span of pelvic fins	8.9	3.4	42.1	28.0	79.0	30.4	98.0	37.7	48	30.7	48.3	32.4
Tail base width	19.8	7.6	10.5	7.0	51.1	19.7	47.6	18.3	32	20.5	14.3	9.6
Tail base depth	25.3	9.7	6.6	4.4	16.1	6.2	16.2	6.2	5.5	3.5	8.8	5.9
Tail length	89.1	34.3	49.3	32.8	131.5	50.6	131.0	50.4	76.8	49.1	58.7	39.4
Snout tip to first dorsal	155.0	59.6	91.1	60.5	165.0	63.5	160.0	61.5	93	59.5	93	62.4
Snout tip to second dorsal	185.0	71.2	105.8	70.3	195.0	75.0	191.0	73.5	111.5	71.3	111	74.5
Snout tip to birth of dorsal caudal	215.0	82.7	122.0	81.1	221.0	85.0	217.0	83.5	124.9	79.9	125	83.9
Snout tip to birth of ventral caudal	213.0	81.9	119.6	79.5	218.0	83.8	215.0	82.7	123.2	78.8	123	82.6
Caudal superior	37.1	14.3	20.1	13.4	39.5	15.2	43.0	16.5	23.9	15.3	23.4	15.7
Caudal inferior edge	34.9	13.4	18.1	12.0	32.1	12.3	34.1	13.1	19.4	12.4	19	12.8
Caudal posterior edge	42.6	16.4	16.0	10.6	40.1	15.4	38.4	14.8	24	15.3	24.1	16.2
First dorsal anterior edge	29.8	11.5	17.1	11.4	29.9	11.5	32.8	12.6	18.2	11.6	18.2	12.2
First dorsal posterior edge	20.7	8.0	9.1	6.1	18.8	7.2	24.6	9.5	11.8	7.5	9.9	6.6
First dorsal inner edge	7.6	2.9	3.7	2.5	1.5	0.6	2.5	1.0	2.5	1.6	4.2	2.8
First dorsal base	17.1	6.6	9.4	6.3	16.5	6.3	19.0	7.3	14.5	9.3	9.6	6.4
Second dorsal anterior edge	24.3	9.3	11.4	7.6	21.3	8.2	25.3	9.7	15.5	9.9	13.8	9.3
Second dorsal posterior edge	15.4	5.9	5.1	3.4	13.1	5.0	15.4	5.9	7.3	4.7	7.2	4.8
Second dorsal inner edge	6.4	2.4	4.2	2.8	0.7	0.3	1.3	0.5	1.3	0.8	4.3	2.9
Second base	14.3	5.5	7.4	4.9	10.5	4.0	13.1	5.0	9.9	6.3	6.9	4.6
Inter-dorsal distance	12.0	4.6	5.5	3.7	10.0	3.8	14.1	5.4	5.3	3.4	6.3	4.2
Second dorsal to caudal birth	15.0	5.8	7.3	4.9	13.1	5.0	13.8	5.3	6.3	4.0	6.8	4.6
Caudal careen	45.0	17.3	18.6	12.3	44.0	16.9	43.0	16.5	14	9.0	15.4	10.3
Clasper length	39.5	15.2					34.1	13.1			18.7	12.6

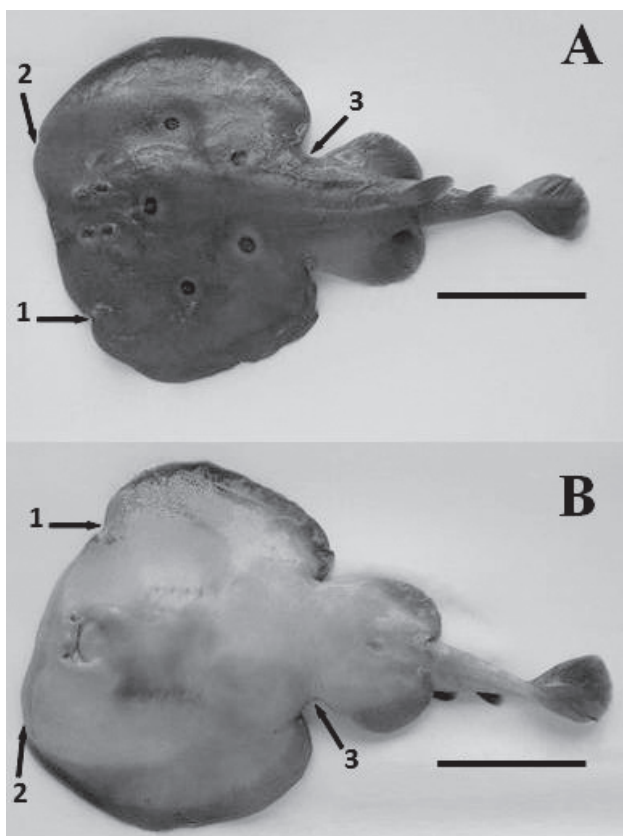
## RESULTS AND DISCUSSION

The first specimen, catalogued FSB T.-torp 08, was a juvenile male, exhibiting flexible claspers and having 260 mm in total length and 259.80 g in total body mass (Fig. 3). The specimen exhibited an incomplete anterior right margin disc due to the fact that the pectoral fin was not totally adherent to the head. Such morphological abnormality was more evident in ventral surface (Fig. 3B, 1) than in dorsal surface (Fig. 3A, 1). The specimen also presented an incomplete left pelvic fin (Fig. 3A, 2; Fig. 3B, 2), which was not the consequence of an injury, because no scar was externally visible on the outer margin of the fin. By contrast, the other regions of the body were normally developed, as showed by percents of total length calculated for specimens FSB T.-torp 08 to FSB T.-torp 13 (Tab. 1). Nineteen specimens of similar size class than specimen FSB T.-torp 08 were collected in the Lagoon of Bizerte; data concerning ranges and means of

their total length and total mass are presented in Table 2, and compared with total length and total mass recorded in the abnormal specimen referenced FSB T.-torp 08. No difference was observed between them.

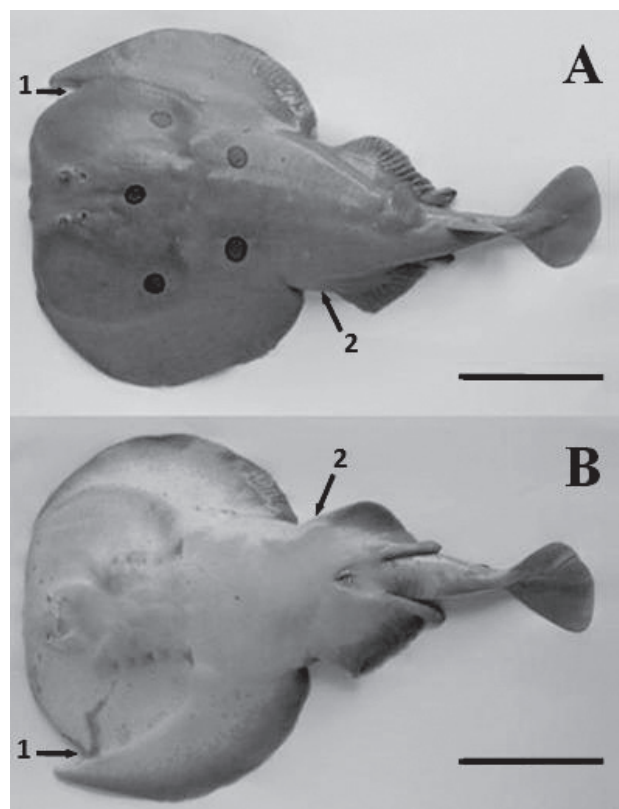
The second specimen, catalogued FSB T.-torp 09, was 150 mm in total length and weighed 47.4 g. It was a juvenile specimen, since in Tunisian waters *Torpedo torpedo* females are considered adult at total length over 275 mm TL (Quignard & Capapé, 1974; Ennajar *et al.*, 2002; El Kamel *et al.*, 2009b). The specimen had both pectoral fins not totally adherent to the head (Fig. 4A, 1, 2, 3; Fig. 4B, 1, 2, 3), but this abnormality was very slight compared to the one described above for specimen FSB T.-torp 08. Additionally, the right pectoral fin of FSB T.-torp 09 is incompletely developed at the distal end of the posterior margin (Figs. 3, 4).

Pectoral fins non adherent to the head were found only in batoid species. Such morphological abnormalities occur when fins fail to fuse together in front of the head in early development, according to Bigelow &



**Fig. 3:** Abnormal *Torpedo torpedo* (FSB T-torp.08), scale bar = 60 mm. A: dorsal surface; B: ventral surface. 1 - right pectoral fin non adherent to the head; 2 - incomplete left pelvic fin.

Sl. 3: Abnormalen primerek *Torpedo torpedo* (FSB T-torp.08), merilo = 60 mm. A: hrbtana stran; B: trebušna stran. 1 - desna prsna plavut se ne stika z glavo; 2 - nepopolna leva trebušna plavut.



**Fig. 4:** Abnormal *Torpedo torpedo* (FSB T-torp.09), scale bar = 30 mm. A: dorsal surface; B: ventral surface. Right pectoral fin (1) and left pectoral fin (2) non adherent to the head; 3 - incomplete left pelvic fin.

Sl. 4: Abnormalen primerek *Torpedo torpedo* (FSB T-torp.09), merilo = 30 mm. A: hrbtana stran; B: trebušna stran. Desna prsna plavut (1) in leva prsna plavut (2) se ne stikata z glavo; 3 - nepopolna leva trebušna plavut.

Schroeder (1953) and Thorson *et al.* (1988). They are commonly recorded in rajid and dasyatid species. 24 similar cases were up to date recorded for rajid species and 11 cases for dasyatid species (Ribeiro-Prado *et al.*, 2008), with hardly any for torpedinid species. Three cases were recorded to date in free swimming specimens (Tab. 2); two cases concerned the marbled electric ray *Torpedo marmorata* Risso, 1810 and a single case concerned the black torpedo *Torpedo nobiliana* Bonaparte, 1835. Mnasri *et al.* (2010) recorded a similar pattern in two embryos carried by a pregnant female *T. torpedo*. Consequently, the two specimens herein described were the first swimming *T. torpedo* which exhibited such abnormality. They did not appear to influence the development and life of these specimens. This observation was in agreement with an interesting instance described by Oldfield (2005) in a female ocellated freshwater stingray *Potamotrygon motoro* (Müller & Henle, 1841) placed

in captivity, which gave birth to a couple of abnormal specimens. Oldfield (2005) noted that the first specimen died two days after birth while the second specimen grew rapidly, and developed a nice colour pattern.

Five specimens presenting different cases of abnormalities were reported from the Lagoon of Bizerte (Tab. 3). This relative occurrence could be explained by the pollution affecting a restricted brackish area such as the Lagoon of Bizerte, polluted by both inorganic and organic nutriment and heavy metals (Mzoughi *et al.*, 2002; Harzallah, 2003). A sustainable population of common torpedos lives buried in sandy and muddy bottoms, where such pollutants are accumulated. Additionally, a genetic origin of these abnormalities cannot be neglected in this isolated population of *T. torpedo* in which migrations from the open sea into this restricted area are reduced to a minimum. However, these suitable hypotheses need further confirmation.

**Tab. 2: Comparison of total length and total mass of abnormal common torpedos (FSB T-torp.08 and FSB T-torp.09) and those of normal specimens of the same size class, all collected in the Lagoon of Bizerte.**

**Tab. 2: Primerjava celotne dolžine in celotne mase abnormalnih primerkov navadnega električnega skata (FSB T-torp.08 in FSB T-torp.09) in normalnih primerkov istega velikostnega razreda, vsi ujeti v Laguni Bizerte.**

Abnormal specimen		Normal specimens	
<b>FSB T-torp.08</b>		N = 19	
Total length (mm)	Total mass (dag)	Total length: range (mean±SD)	Total mass: range (mean±SD)
260	259.8	258-261 (259.7±1.1)	194.8-274.9 (252.1±35.5)
<b>Abnormal specimen</b>		<b>Normal specimens</b>	
<b>FSB T-torp.09</b>		N = 9	
Total length (mm)	Total mass (dag)	Total length: range (mean±SD)	Total mass: range (mean±SD)
150.4	47.4	139-160 (148.8±8.2)	48.4-71.1 (55.2±6.5)

**Tab. 3: Morphological abnormalities recorded in the ichthyological literature in specimens of the genus *Torpedo*.**

**Tab. 3: Morfološke nepravilnosti, zabeležene v ihtiološki literaturi pri primerkih iz rodu *Torpedo*.**

Species	Case of abnormality	Marine region	Authors
<i>T. marmorata</i>	Pectoral non adherent to the head	Adriatic Sea	Valle (1931)
<i>T. marmorata</i>	Pectoral non adherent to the head	Adriatic Sea	Jardas & Homen (1977)
<i>T. nobiliana</i>	Pectoral non adherent to the head	Atlantic Ocean	Palmer & Wheeler (1958)
<i>T. torpedo</i>	Surnumerary dorsal fin	Lagoon of Bizerte	Ben Brahim & Capapé (1997)
<i>T. torpedo</i>	Lack of gill-slit	Lagoon of Bizerte	El Kamel <i>et al.</i> (2009a)
<i>T. torpedo</i>	Pectoral non adherent to the head	Lagoon of Bizerte	Mnasri <i>et al.</i> (2010)
<i>T. torpedo</i>	Pectoral non adherent to the head	Lagoon of Bizerte	Mnasri <i>et al.</i> (2010)
<i>T. torpedo</i>	Pectoral non adherent to the head Pelvic fin incomplete	Lagoon of Bizerte	This study
<i>T. torpedo</i>	Pectoral non adherent to the head Pelvic fin incomplete	Lagoon of Bizerte	This study

# NEPRAVILNOSTI PRI NAVADNEM ELEKTRIČNEM SKATU, *TORPEDO TORPEDO* (CHONDRICHTHYES: TORPEDINIDAE) IZ LAGUNE BIZERTE (SEVERNA TUNIZIJA, OSREDNJE SREDOZEMLJE)

Olfa EL KAMEL-MOUTALIBI, Néjia MNASRI & Moncef BOUMAÏZA

Laboratoire d'Hydrobiologie Littorale et Limnique, Université du 07 novembre à Carthage, Faculté des Sciences, Zarzouna, 7021 Bizerte, Tunisia

Christian REYNAUD & Christian CAPAPÉ

Laboratoire interdisciplinaire de Recherche sur la Didactique, l'Éducation et la Formation, E. A. 3749, case 77, Université Montpellier II, Sciences et Techniques du Languedoc, 34095 Montpellier cedex 5, France  
E-mail: capape@univ-montp2.fr

## POVZETEK

Avtorji članka poročajo o dveh abnormalnih primerkih električnega skata *Torpedo torpedo* Linnaeus 1758, ujetih v Laguni Bizerte, severovzhodna Tunizija. Pri obeh primerkih, eden je mladostni primerek samca, drugi pa mladostni primerek samice, so zabeležili enaki nepravilnosti, in sicer prsno plavut, ki se ne stika z glavo, in nepopolno trebušno plavut. Primerka sta opisana, njune atipične karakteristike pa komentirane in diskutirane.

**Ključne besede:** Chondrichthyes, *Torpedo torpedo*, nepravilnosti, Laguna Bizerte, severna Tunizija

## REFERENCES

- Albuquerque, M. R. (1954-1956):** Peixes de Portugal. Port. Acta Biol., 5, 1-1164.
- Ben Brahim, R. & C. Capapé (1997):** Nageoire dorsale supplémentaire chez une torpille ocellée, *Torpedo (Torpedo) torpedo* des eaux tunisiennes (Méditerranée Centrale). Cybium, 21(2), 223-225.
- Ben Brahim, R., A. A. Seck & C. Capapé (1998):** Albinisme chez la torpille ocellée, *Torpedo (Torpedo) torpedo* (Linnaeus, 1758). Cybium, 22(1), 83-86.
- Bigelow, H. B. & W. C. Schroeder (1953):** Fishes of the western north Atlantic. Part 2. Sawfishes, guitarfishes, skates, rays and chimaeroids. Mem. Sears Found. Mar. Res., 2, 1-588.
- Bradaï, M. N., J.-P. Quignard, A. Bouain, O. Jarboui, A. Ouannes-Ghorbel, L. Ben Abdallah, J. Zaouali J. & S. Ben Salem (2004):** Ichtyofaune autochtone et exotique des côtes tunisiennes: Recensement et biogéographie. Cybium, 28(4), 315-328.
- Capapé, C. (1989):** Les Sélaciens des côtes méditerranéennes: aspects généraux de leur écologie et exemples de peuplements. Océanis, 15, 309-331.
- Capapé, C. & M. Desoutter (1981):** Nouvelle description de *Torpedo (Torpedo) torpedo* (Linné, 1758) (Pisces, Torpedinidae). Bull. Mus. Hist. Natl. Paris 7A, 4, 1205-1217.
- Capapé, C., O. Guélorget, J.-P. Quignard, A. El Abed, J. Zaouali & J. Bensouissi (2004):** The Elasmobranch species from the Bahiret El Biban (Southern Tunisia, Central Mediterranean): a survey. Annales, Ser. Hist. Nat., 14(1), 19-28.
- El Kamel, O., N. Mnasri, M. Boumaïza & C. Capapé (2009a):** Atypical abnormality in a common torpedo, *Torpedo torpedo* (Chondrichthyes: Torpedinidae) from the Lagoon of Bizerte (northern Tunisia, central Mediterranean). Cah. Biol. Mar., 50(1), 97-101.
- El Kamel, O., N. Mnasri, J. Ben Souissi, M. Boumaïza, M. M. Ben Amor & C. Capapé (2009b):** Inventory of elasmobranch species caught in the Lagoon of Bizerte (north-eastern Tunisia, central Mediterranean). PANAM-JAS, 4(4), 383-412.
- Ennajar, S., M. N. Bradaï & A. Bouain (2002):** La reproduction de la torpille ocellée *Torpedo (Torpedo) torpedo* (Linnaeus, 1758) du Golfe de Gabès. Bull. Inst. Sci. Technol. Mer Salammbô, num. spéc. 7, 40-43.
- Harzallah, A. (2003):** Transports de polluants dans la lagune de Bizerte simulé par un modèle de circulation de l'eau. Bull. Inst. Sci. Technol. Mer Salammbô, num. spéc. 30, 121-133.
- Jardas, I. & Z. Homen (1977):** Nouvelles trouvailles sur les anomalies anatomiques des exemplaires tératologiques des poissons adriatiques. Biljeske-Notes, 34, 1-10.

**Lloris, D. & J. Rucabado (1998):** Guide FAO d'identification des espèces pour les besoins de la pêche. Guide d'identification des ressources marines vivantes pour le Maroc. FAO, Rome, 263 p.

**Mejri, H., J. Ben Souissi, J. Zaouali, A. El Abed, O. Guélorget & C. Capapé (2004):** On the recent occurrence of elasmobranch species in a perimediterranean lagoon: the Tunis Southern Lagoon (Northern Tunisia). *Annales, Ser. Hist. Nat.*, 14(2), 143-158.

**Mnasri, N., O. El Kamel, M. Boumaïza, M. M. Ben Amor, C. Reynaud & C. Capapé (2010):** Morphological abnormalities in two batoid species (Chondrichthyes) from northern Tunisian waters (central Mediterranean). *Annales, Ser. Hist. Nat.*, 20(2), 181-190.

**Mzoughi, N., F. Hellal, M. Dachraoui, J.-P. Vileuneuve, C. Cattini, S. de Mora & A. El Abed (2002):** Méthodologie de l'extraction des hydrocarbures polycycliques. Application à des sédiments de la lagune de Bizerte (Tunisie). *C. R. Géosciences*, 334, 893-901.

**Oldfield, R. (2005):** Biology, husbandry, and reproduction of freshwater stingrays. On-line: <http://deep-blue.lib.umich.edu/index.jsp>

**Palmer, G. & A. C. Wheeler (1958):** Teratological example of an electric ray, *Torpedo nobiliana* Bonaparte. *Proc. Zool. Soc. London*, 130, 449-454.

**Quéro, J. C., P. Porché & J. J. Vayne (2003):** Guide des poissons de l'Atlantique européen. Les Guides du naturaliste. Delachaux and Niestlé, Lonay (Switzerland)-Paris, 465 p.

**Quignard, J.-P. & C. Capapé (1974):** Recherches sur la biologie d'un Sélacien du golfe de Tunis, *Torpedo torpedo* Linné, 1758 (Ecologie, sexualité, reproduction). *Bull. Inst. Natl. Sci. Tech. Oceanogr. Pêché Salammbô*, 2(2), 131-141.

**Ribeiro-Prado, C. C., M. C. Oddone, M. M. Bueno Gonzalez, A. Ferreira de Amorim & C. Capapé (2008):** Morphological abnormalities in Skates and Rays (Chondrichthyes) from off Southeastern Brazil. *Arqui. Cienc. Mar*, 41(2), 21-28.

**Smith, M. M. & P. C. Heemstra (1986):** Smiths's sea fishes. Springer-Verlag, Berlin, 1047 p.

**Thorson, T. B., J. K. Langhammer & M. I. Oettinger M. (1988):** Reproduction and development of the South American freshwater stingrays, *Potamotrygon circularis* and *P. motoro*. *Environ. Biol. Fish.*, 23, 299-314.

**Valle, A. (1931):** Contributo alla teratologia dei Crostacei e dei Pesci Adriatici. *Atti Mus. Civ. Stor. Nat. Trieste*, 11(2), 360-363.

Short scientific article  
Received: 2011-09-30

UDK 597.311.2:591.9(262-11)

## ADDITIONAL RECORDS OF THE BIGEYE THRESHER SHARK *ALOPIAS SUPERCILIOSUS* (LOWE, 1839) (CHONDRICHTHYES: LAMNIFORMES: ALOPIIDAE) FROM TURKISH WATERS

*Hakan KABASAKAL*

Ichthyological Research Society, Tantavi Mahallesi, Menteşoğlu Caddesi, Idil Apt., No. 30, D: 4, Ümraniye, TR-34764 Istanbul, Turkey  
E-mail: hakankabasakal@superposta.com

*Cem DALYAN*

Istanbul University, Faculty of Science, Department of Biology, Vezneciler, TR-34134, İstanbul, Turkey

*Adem YURTSEVER*

Ichthyological Research Society, Tantavi Mahallesi, Menteşoğlu Caddesi, Idil Apt., No. 30, D: 4, Ümraniye, TR-34764 Istanbul, Turkey

### ABSTRACT

*Recent captures of the bigeye thresher shark, Alopias superciliosus (Lowe, 1839) from Turkish waters are reported. Available data confirmed that the distribution range of A. superciliosus extends to the Sea of Marmara. Regarding the size of specimen No 2, 450 cm TOT, it is one of the largest bigeye thresher sharks ever recorded in the Mediterranean Sea, and worldwide. Due to scarce existing data, no speculations could be made upon the status of pelagic sharks in Turkish waters and the time trend in catches (declining, stable or increasing). Therefore, further study is needed to monitor and assess the current status of bigeye thresher sharks caught off Turkish coast.*

**Keywords:** bigeye thresher, Alopiidae, *Alopias superciliosus*, Turkey, eastern Mediterranean

## NUOVE SEGNALAZIONI DI SQUALO VOLPE OCCHIONE, *ALOPIAS SUPERCILIOSUS* (LOWE, 1839) (CHONDRICHTHYES: LAMNIFORMES: ALOPIIDAE), IN ACQUE DELLA TURCHIA

*SINTESI*

*L'articolo segnala catture recenti di squalo volpe occhione, Alopias superciliosus (Lowe, 1839), in acque della Turchia. I dati disponibili confermano che il range di distribuzione di A. superciliosus si estende fino al Mar di Marmara. L'esemplare catturato No 2, con una lunghezza totale pari a 450 cm, è uno degli individui di squalo volpe occhione più larghi mai segnalati per il mare Mediterraneo, e per l'intero pianeta. In merito allo stato degli squali pelagici delle acque turche, vista la scarsità di dati, nessuna speculazione può venir fatta in merito alla tendenza temporale delle catture (in calo, stabile o in aumento). Pertanto gli autori concludono che siano necessari ulteriori studi per monitorare e capire lo stato attuale degli esemplari di squalo volpe occhione, che vengono catturati nelle acque al largo della Turchia.*

**Parole chiave:** squalo volpe occhione, Alopiidae, *Alopias superciliosus*, Turchia, Mediterraneo orientale

## INTRODUCTION

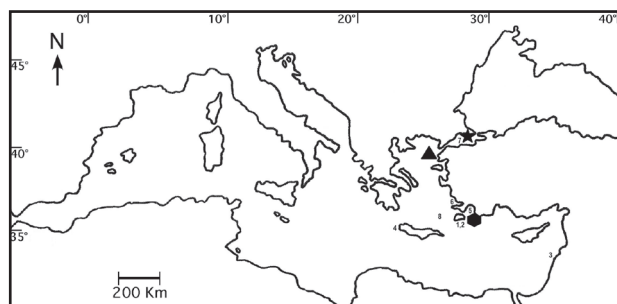
The bigeye thresher shark, *Alopias superciliosus* (Lowe, 1839), is a cosmopolitan species occurring in the Atlantic, Pacific and Indian Oceans (Quéro, 1984). It is found in warm to temperate waters in its distribution range and occurs in coastal waters over the continental shelves, sometimes close inshore in shallow waters (Compagno, 1984). *A. superciliosus* has been listed among the Mediterranean ichthyofauna by several researchers (e.g., Quéro, 1984; De Maddalena & Baensch, 2005; Serena 2005). Its occurrence in the Mediterranean was unknown until the beginning of the 1980s, when it was recorded for the first time in the Ionian Sea (Gruber & Compagno, 1981), followed by the capture of four specimens by the fishermen of Mazara del Vallo (Trapani) in the Sicilian Channel (Cigala Fulgosi, 1983). However, a recent study by Corsini-Foka & Sioulas (2009) suggests that the oldest samples of the bigeye thresher shark could have been recorded in Mediterranean waters during the 1950s, based on two males of 310 and 450 cm TOT, caught in Dodecanese waters and preserved as embalmed specimens at the Hydrobiological Station of Rhodes collection.

*A. superciliosus* is listed also among the fish fauna of the eastern part of the Mediterranean basin (Golani *et al.*, 2006). The first occurrence of the bigeye thresher shark in Aegean waters was mentioned by Megalofonou *et al.* (2005), after surveys carried out during 1998–2001. More recently, the species was recorded from Gökova Bay on 23 May 2005, which was the first record of *A. superciliosus* in Turkish waters, and followed by its Marmaric record (Kabasakal & Karhan, 2007). Complete set of jaws of the latter Marmaric specimen is currently preserved at the Ichthyological Research Society (IRS) collection in İstanbul, Turkey.

In the present article, authors report on the recent captures of the bigeye thresher shark in Turkish waters.

## MATERIAL AND METHODS

This study is a part of an extensive research, which was initiated by IRS in 2000, to determine the status of sharks that occurred in the seas of Turkey. Three specimens of *Alopias superciliosus* were caught by commercial fishing vessels on different localities along the Turkish coast (Fig. 1). The present specimens of thresher sharks were identified as *A. superciliosus* based on following diagnostic characters (Compagno, 1984): snout rather long; a deep horizontal groove on each side of nape; eyes large, reaching the dorsal surface of the head (Figs. 2, 3, 4). The following data were recorded for each specimen whenever possible: total length (TOT, in Compagno, 1984), weight, sex, capture locality, type of fishing gear, date of capture, and depth of capture. Photographs of the specimens are kept in the IRS archives and available for inspection on request.



**Fig. 1:** Map showing the locality of recent captures (symbols) and previous records (numerals) of the bigeye thresher sharks off Turkish coast, as well as in the eastern Mediterranean.

**Legend:** ★ denotes specimen No 1; ● denotes specimen No 2; ▲ denotes specimen No 3, recorded in the present study; 1, 2 denote specimens recorded by Corsini-Foka & Sioulas (2009) in the early 1950's; 3 denotes two neonates caught off Israel (Clo *et al.*, 2008); 4 denotes a specimen caught off western Crete (Clo *et al.*, 2008); 5 denotes a specimen caught off Marmaris in 2004 (Clo *et al.*, 2008); 6 denotes a specimen caught in Gökova Gulf in 2005 (Kabasakal & Karhan, 2007); 7 denotes a specimen caught in the Sea of Marmara in 2007 (Kabasakal & Karhan, 2007); 8 denotes two specimens caught in the Aegean Sea (Megalofonou *et al.*, 2005).

**Sl. 1:** Zemljevid z označenimi točkami ulova velikookih morskih lisic ob obalah Turčije in v vzhodnem Sredozemlju, novejši (simboli) in starejši podatki (številke).

**Legenda:** ★ označuje primerek št. 1; ● označuje primerek št. 2; ▲ označuje primerek št. 3, vsi obravnavani v pričujoči raziskavi; 1, 2 označujeta primerka, ki sta ju zabeležila Corsini-Foka & Sioulas (2009) v zgodnjih 1950-ih; 3 označuje dva novorojena primerka, ujeta ob obali Izraela (Clo *et al.*, 2008); 4 označuje primerek, ujet ob zahodni obali Krete (Clo *et al.*, 2008); 5 označuje primerek, ujet pri kraju Marmaris leta 2004 (Clo *et al.*, 2008); 6 označuje primerek, ujet v Zalivu Gökova leta 2005 (Kabasakal & Karhan, 2007); 7 označuje primerek, ujet v Marmarskem morju leta 2007 (Kabasakal & Karhan, 2007); 8 označuje dva primerka, ujeta v Egejskem morju (Megalofonou *et al.*, 2005).

## RESULTS AND DISCUSSION

Specimen No 1 (Fig. 2) was a male, captured off Sivrice coast (NE Aegean Sea) on 21 May 2006, by means of a stationary net set at a depth of nearly 100 m. Its total length was 4 m; the weight could not be recorded. Claspers were calcified and stiff, seminal fluid was observed at the tip of claspers upon the compression of sperm sacs.

Specimen No 2 (Fig. 3) was captured off Fethiye coast (eastern Mediterranean Sea, Turkey) on 28 February 2011, by means of a trammel-net (inner mesh 30

**Tab. 1: Selected morphometric measurements of *A. superciliosus* (Lowe, 1839) specimen No 2 caught off Fethiye.**

**Tab. 1: Izbrani morfometrični podatki za vrsto *A. superciliosus* (Lowe, 1839) primerek št. 2, ujet ob kraju Fethiye.**

Measurement	cm	% of TL
Total length (TL)	450	
First dorsal fin length	41	9.1
First dorsal fin base length	32	7.1
Pectoral fin length	82	18.2
Pectoral fin base length	30	6.6
Ventral fin length	39	8.6
Ventral fin base length	30	6.6
Predorsal length	128	28.4
Preventral length	165	36.6
Prepectoral length	55	12.2
Tail length	217	48.2

mm, outer mesh 120 mm) on a mixed bottom of sand and pebbles at the depth of 110 m. It was a female of 450 cm TOT and weighing 300 kg. Morphometric measurements were recorded by the first author at the site of display (Tab. 1). According to fishermen's statements, the shark was entangled in the net during early hours of dawn. A row of 24 of teeth on upper jaw and a row of 23 teeth on lower jaw. Dental formula of the examined specimen is 12-12 / 11-12.

Specimen No 3 (Fig. 4), a female of 2.5 m TOT and weighing 65 kg, was caught by a commercial purse-seine on 2 July 2011 off Silivri coast (the northern Sea of

Marmara). It was examined by the third author and photographed in a shopping mall near Istanbul city, where it was displayed to public at a fishmonger.

The bigeye thresher shark grows to a large size, and attains a maximum size of 461 cm TOT (Smith *et al.*, 2008). According to Gruber & Compagno (1981), the heaviest reliably reported specimen was a female from Cuba, weighing 284.5 kg, which corresponds to a pre-caudal length of 237 cm and a total length of about 452 cm. Regarding the size of the specimen No 2, 450 cm TOT and weighing 300 kg, it is one of the largest bigeye thresher sharks ever recorded in the Mediterranean Sea, and worldwide, as well.

The first record of *A. superciliosus* in the Sea of Marmara dates back to 25 February 2007 (Kabasakal & Karhan, 2007). The recent capture of the specimen No 3 off Silivri coast confirms the extension of the Mediterranean distribution of the bigeye thresher shark to the Sea of Marmara.

Interviews with the local fishermen revealed that the bigeye thresher shark is a very rare bycatch of commercial fishing boats operated off Fethiye coast. The rarity of *A. superciliosus* in the eastern Mediterranean was emphasized after an extensive survey of the pelagic sharks occurring in the region also by Megalofonou *et al.* (2005). During the 3 year survey on board of pelagic fishing boats, only 2 specimens of *A. superciliosus* were recorded by the authors. Previous and recent records of the bigeye thresher shark in the eastern Mediterranean are shown on the map (Fig. 1). In the regional assessment of Chondrichthyans in the Mediterranean Sea, the IUCN Shark Specialist Group listed the species as data deficient (Cavanagh & Gibson, 2007). For the moment, it is not clear whether the bigeye thresher shark is rare



**Fig. 2: Specimen No 1 (★ in Fig. 1) captured off Sivrice coast on 21 May 2006. Arrow denotes a groove on the nape. (Photo: İ. Öz)**

**Sl. 2: Primerek št. 1 (★ na Sl. 1), ujet ob obali Sivrice 21. maja 2006. Puščica kaže na brazdo na tilniku. (Foto: İ. Öz)**



**Fig. 3:** Specimen No 2 (● in Fig. 1) captured off Fethiye coast on 28 February 2011. (Photo: IRS archive)  
**Sl. 3:** Primerek št. 2 (● na Sl. 1), ujet ob obali Fethiye 28. februarja 2011. (Foto: arhiv IRS)

in the Mediterranean, or just rarely caught or reported. According to Serena (2005), *A. superciliosus* is an occasional/rare species in the entire Mediterranean; however, recent multiple records from the eastern basin and Sicilian Channel, which were reviewed by Clo *et al.* (2008), as well as the historical occurrence of several specimens (Corsini-Foka & Sioulas, 2009), indicate that it cannot be considered a vagrant in these areas. According to De Maddalena & Baensch (2005), the species can't be considered rare in the Mediterranean and, at least in some areas, may be relatively common. The specimens described here are the most recent proof of the occurrence of *A. superciliosus* in the eastern Mediterranean. Like other pelagic sharks, *A. superciliosus* is not a targeted species of Turkish fishermen; however, every fishing season, unknown number of specimens are accidentally captured and landed, especially by pelagic fishing ves-



**Fig. 4:** Specimen No 3 (▲ in Fig. 1) captured off Silivri coast on 2 July 2011. Arrow denotes a groove on the nape. (Photo: A. Yurtsever)  
**Sl. 4:** Primerek št. 3 (▲ na Sl. 1), ujet ob obali Silivri 2. julija 2011. Puščica kaže na brazdo na tilniku. (Foto: A. Yurtsever)

sels. Due to scarce existing data, no speculations could be made upon the status of pelagic sharks in Turkish waters and the time trend in catches (declining, stable or increasing). Therefore, further study is needed to monitor and assess the current status of bigeye thresher sharks, as well as other pelagic sharks, caught off Turkish coast.

#### ACKNOWLEDGMENTS

Authors wish to thank Mr. İsmet Öz, an Istanbul based SCUBA diver, who provided the photographs and information on specimen No 1, and the fisherman Tevfik Çimen for the opportunity to examine specimen No 2. Hakan Kabasakal extends his deep gratitude to his wife Özgür, and to his son Derin, for their endless love and support.

NOVI PODATKI O VELIKOOKI MORSKI LISICI *ALOPIAS SUPERCILIOSUS* (LOWE, 1839) (CHONDRICHTHYES: LAMNIFORMES: ALOPIIDAE) V TURŠKIH VODAH

Hakan KABASAKAL

Ichthyological Research Society, Tantavi Mahallesi, Menteşoğlu Caddesi, Idil Apt., No. 30, D: 4, Ümraniye, TR-34764 Istanbul, Turkey  
E-mail: hakankabasakal@superposta.com

Cem DALYAN

Istanbul University, Faculty of Science, Department of Biology, Vezneciler, TR-34134, İstanbul, Turkey

Adem YURTSEVER

Ichthyological Research Society, Tantavi Mahallesi, Menteşoğlu Caddesi, Idil Apt., No. 30, D: 4, Ümraniye, TR-34764 Istanbul, Turkey

## POVZETEK

Avtorji v članku poročajo o pred kratkim ujetih velikookih morskih lisicah *Alopias superciliosus* (Lowe, 1839) v turških vodah. Razpoložljivi podatki tako potrjujejo, da se območje razširjenosti *A. superciliosus* razteza vse do Marmarskega morja. Glede na izmerjeno dolžino primerka št. 2, 450 cm TOT, lahko trdimo, da gre za eno največjih velikookih morskih lisic kdajkoli opaženo v Sredozemskem morju in na svetu. Zaradi pomanjkanja podatkov ne moremo sklepati o statusu pelagičnih morskih psov v turških vodah in časovnem trendu ulova (v upadu, stabilen ali v porastu). Potrebne bi bile nadaljnje raziskave, s katerimi bi opazovali in ocenili status velikookih morskih lisic, ujetih ob obalah Turčije.

**Ključne besede:** velikooka morska lisica, Alopidae, *Alopias superciliosus*, Turčija, vzhodno Sredozemlje

## REFERENCES

- Cavanagh, R. D. & C. Gibson (2007):** Overview of the conservation status of cartilaginous fishes (Chondrichthyans) in the Mediterranean Sea. IUCN, Gland, Switzerland and Malaga, Spain, 42 p.
- Cigala Fulgosi, F. (1983):** First record of *Alopias superciliosus* (Lowe, 1839) in the Mediterranean, with notes on some fossil species of the genus *Alopias*. Ann. Mus. Civ. Stor. Nat. Genova, 84, 211–229.
- Clo, S., R. Bonfil & E. De Sabata (2008):** Additional records of the bigeye thresher shark, *Alopias superciliosus*, from the central and eastern Mediterranean Sea. JMBA2, Biodiversity Records, 6168. <http://www.mba.ac.uk/jmba/jmba2biodiversityrecords.php>
- Compagno, L. J. V. (1984):** FAO species catalogue. Vol. 4. Sharks of the world. An annotated and illustrated catalogue of shark species known to date. Part 1. Hexanchiformes to Lamniformes. FAO Fish. Synop., 4, 1–249.
- Corsini-Foka, M. & A. Sioulas (2009):** On two old specimens of *Alopias superciliosus* (Chondrichthyes: Alopidae) from the Aegean waters. Mar. Biodiversity Rec., 2; e72.
- De Maddalena A. & H. Baensch (2005):** Haie im Mittelmeer. Franckh-Kosmos Verlags-GmbH & Co., Stuttgart, 240 p.
- Golani, D., B. Öztürk & N. Başusta (2006):** Fishes of the eastern Mediterranean. Turkish Marine Research Foundation, Publication no. 24. Istanbul, Turkey, 259 p.

**Gruber, S. H. & L. J. V. Compagno (1981):** Taxonomic status and biology of the bigeye thresher shark, *Alopias superciliosus* (Lowe, 1839). Fishery Bulletin, National Marine Fisheries Service 79, 617-640.

**Kabasakal, H. & S. Ü. Karhan (2007):** On the occurrence of the bigeye thresher shark, *Alopias superciliosus* (Chondrichthyes: Alopiidae), in Turkish waters. JMBA2, Biodiversity Records 5745, <http://www.mba.ac.uk/jmba/jmba2biodiversityrecords.php>

**Megalofonou, P., D. Damalas & C. Yannopoulos (2005):** Composition and abundance of pelagic shark by-catch in the eastern Mediterranean Sea. Cybium, 29, 135-140.

**Quéro, J.-C. (1984):** Alopiidae. In: Whitehead, P. J. P., M.-L. Bauchot, J.-C. Hureau, J. Nielsen & E. Tortonese (eds.): Fishes of the North-Eastern Atlantic and Mediterranean, Vol. 1. UNESCO, Paris, pp. 91-92.

**Serena, F. (2005):** Field identification guide to the sharks and rays of the Mediterranean and Black Sea. FAO Species Identification Guide for Fishery Purposes. FAO, Rome.

**Smith, S. E., R. C. Rasmussen, D. A. Ramon & G. M. Cailliet (2008):** The biology and ecology of thresher sharks (Alopiidae). In: Camhi, M. D., E. K. Pikitch, E. A. Babcock (eds.): Sharks of the Open Ocean: Biology, Fisheries and Conservation. Blackwell Publishing, Oxford, UK, pp. 60-68.

Short scientific article  
Received: 2011-07-22

UDK 591.159:597.556.33(535)

## PRELIMINARY STUDY ON ASYMMETRY IN MORPHOLOGICAL CHARACTERS OF *PENTAPRION LONGIMANUS* (OSTEICHTHYES: GERRIDAE) FROM THE SEA OF OMAN

*Laith A. JAWAD & Juma M. AL-MAMRY*

Marine Science and Fisheries Centre, Ministry of Agriculture and Fisheries Wealth, PO Box 427, Post Code 100, Muscat, Sultanate of Oman  
E-mail: laith\_jawad@hotmail.com

*Amal M. AL-HINAI & Maryam A. AL-RASHIDI*

High Technical College, Muscat, Sultanate of Oman

*Haithem K. AL-BUSAIDI*

Marine Science and Fisheries Centre, Ministry of Agriculture and Fisheries Wealth, PO Box 427, Post Code 100, Muscat, Sultanate of Oman

### ABSTRACT

*The fluctuating asymmetry in *Pentaprion longimanus*, was estimated by determining the number of rays in pectoral fins and measurement of four body morphometric characters, i.e. preorbital length, postorbital length, orbital diameter and head length on both sides of the body in 91 individuals from the population of *P. longimanus*, collected from the waters off Muscat City, The Sea of Oman. Units of asymmetry were determined as the absolute value of difference between counts on both sides of body. Results indicate that pre and postorbital length and the number of pectoral fin rays demonstrate a higher level of asymmetry than the rest of the characters studied. In the pre and postorbital lengths we also noticed the trend of increase in the asymmetry values with the fish length. The possible cause of the asymmetry in this species was discussed in relation to different pollutants and their presence in the area. The usefulness of the information in future taxonomic studies on *P. longimanus* was also addressed.*

**Keywords:** fluctuating asymmetry (FA), Sea of Oman, Sultanate of Oman, *Pentaprion longimanus*, indicator

## STUDIO PRELIMINARE SULL'ASIMMETRIA DEI CARATTERI MORFOLOGICI DI *PENTAPRION LONGIMANUS* (OSTEICHTHYES: GERRIDAE) DEL MARE DELL'OMAN

### SINTESI

*L'Asimmetria Fluttuante di *Pentaprion longimanus* è stata valutata grazie alla determinazione del numero dei raggi delle pinne pettorali e alla misurazione di quattro caratteri corporei morfometrici: lunghezza preorbitale, lunghezza postorbitale, diametro orbitale e lunghezza del capo da entrambi i lati del corpo, in 91 individui provenienti da una popolazione di *P. longimanus* catturata nelle acque al largo della città di Mascate, nel mare dell'Oman. Le unità di asimmetria sono state determinate come valore assoluto della differenza fra i conteggi effettuati su entrambi i lati del corpo. I risultati indicano che le lunghezze pre- e postorbitali e il numero dei raggi delle pinne pettorali dimostrano un livello di asimmetria maggiore rispetto agli altri caratteri studiati. Riguardo alle lunghezze pre e postorbitali è stato inoltre notato un aumento nei valori dell'asimmetria all'aumentare della lunghezza corporea. Gli autori discutono la possibile causa di asimmetria in questa specie in relazione ai diversi inquinanti e alla loro presenza nell'area. L'articolo evidenzia pure l'utilità di tale informazione per studi tassonomici futuri su *P. longimanus*.*

**Parole chiave:** asimmetria fluttuante (FA), mare dell'Oman, Sultanato dell'Oman, *Pentaprion longimanus*, indicatore

## INTRODUCTION

The longfin mojarra, *Pentaprion longimanus* (Cantor, 1849) is a tropical demersal species distributed in the Indo-West Pacific, mainly in the Sea of Oman, western and southern coasts of India and off Sri Lanka to Indonesia. It is also reported from the Philippines, the Ryukyu Islands and southern to northern parts of Australia (Froese & Pauly, 2010). This species inhabits coastal waters and forms large schools. It feeds on small benthic animals. In Oman, the longfin mojarra is considered commercially important as its landing reached 10 000 tons in 2010 (Fish Statistics, 2010). It represents an important part of the everyday Omani diet and is also used as dry fish commodity (Al-Abdessalaam, 1995).

There are numerous studies investigating the impact of miscellaneous environmental stressors on developmental stability and the variety of organisms studied is wide (Eriksen *et al.*, 2008). However, the only published study on the fluctuating asymmetry in Omani fish species is that of Jawad *et al.* (2010), therefore, the present study is considered a quantitative and qualitative addition to the previous studies on Omani fish fauna.

The objectives of the present preliminary study were to determine the extent and direction of the asymmetry in some morphological characters of *Pentaprion longimanus* and the possible usefulness of the information in future taxonomic studies of *P. longimanus*.

## MATERIALS AND METHODS

Sultanate of Oman lies on the coasts of two seas, the Sea of Oman and the Arabian Sea. The country has an extensive coastline of 3,165 km, on the Sea of Oman

in the north and the Arabian Sea in the south. Muscat is located in NE Oman, at 24°00' N and 57°00' E with the Sea of Oman at the northern and western periphery of the city.

A total of 91 specimens of *Pentaprion longimanus* were collected from the Muscat coastal area, the Oman Sea (Fig. 1). Five bilateral characters used to compare asymmetry were recorded as follows: (1) length of the pre-orbital distance (mm): measured from mouth to the anterior edge of the orbit; (2) length of the post-orbital distance (mm): measured from the posterior edge of the eye to the posterior edge of the operculum; (3) orbital diameter (mm): measured from the anterior to the posterior edges of the eye; (4) head length (mm): measured from mouth to the posterior edge of operculum; (5) number of pectoral fin rays: count of the total number of pectoral fin rays, including the most upper ray. Most characters were counted and measured under a binocular dissecting microscope. For specimens too large to fit under a microscope, a magnifying glass was used.

The statistical analysis included calculating the square coefficient of asymmetry variation ( $CV_a^2$ ) for metric and meristic characters according to Valentine *et al.* (1973):

$$CV_a^2 = (S_{r-l} \times 100 / X_{r+l})^2$$

where  $S_{r-l}$  is the standard deviation of the signed difference and  $X_{r+l}$  is the mean of the character, calculated by adding the absolute scores for both sides and dividing by the sample size. To eliminate scaling problems associated with growth in metric characters, each measurement was divided by suitable general size measurements, e.g. head length was used as the standardizing measurement. Each of the metric characters was treated in this manner before obtaining the signed differences.

## RESULTS

The results of asymmetry data analysis of the previously listed characters of *Pentaprion longimanus* collected from the Muscat coastal area, the middle part of the Oman Sea, are shown in Table 1. The highest values were recorded for the pre and postorbital length and the number of pectoral fin rays, and the lowest value for the head length.

The percentage of individuals showing asymmetry in the postorbital length character was the highest among the percentages recorded for the five characters (85.71% of the total fish studied) and the lowest percentage was for individuals with asymmetry in preorbital length (65.93% of the total fish studied). Individuals of *P. longimanus* were grouped into length classes (Tab. 2). An increasing trend in the asymmetry value with fish length was noticed for preorbital and postorbital lengths ( $P < 0.05$ ).

The results have shown that all the characters studied are dextral, with the right side showing higher value



**Fig. 1: Map showing the collection site of the specimens of *Pentaprion longimanus*.**

**Sl. 1: Zemljevid, ki prikazuje lokacijo ulova primerkov vrste *Pentaprion longimanus*.**

**Tab. 1: Square coefficient of asymmetry variation ( $CV_a^2$ ) values and character means ( $X_{r+l}$ ) of *P. longimanus*.****Tab. 1: Vrednosti kvadratnega koeficienta asimetrije ( $CV_a^2$ ) in povprečne vrednosti morfoloških znakov ( $X_{r+l}$ ) vrste *P. longimanus*.**

Character	$CV_a^2$	N	Character mean	% of individuals with asymmetry
Preorbital length	328.29	91	8.91	65.93
Postorbital length	418.73	91	9.52	85.81
Eye diameter	92.90	91	9.66	73.63
Number of pectoral fin rays	478.98	91	9.61	78.02
Head length	50.50	91	22.76	75.82

**Tab. 2: Square coefficient of asymmetry variation and character means ( $X_{r+l}$ ) by size class of *P. longimanus*.****Tab. 2: Kvadratni koeficient asimetrije in povprečne mere telesnih morfoloških znakov ( $X_{r+l}$ ) za posamezne velike razrede vrste *P. longimanus*.**

Size class	n	$CV_a^2$	character mean $X_{r+l}$	% of individuals with asymmetry
Preorbital length				
10.1-11.0	3	81.29	6.92	66.67
11.1-12.0	23	92.48	8.08	78.26
12.1-13.0	31	98.13	8.88	67.74
13.1-14.0	30	101.87	9.57	63.33
14.1-15.0	4	105.45	10.50	0
Total	91			
Postorbital length				
10.1-11.0	3	43.83	6.17	66.67
11.1-12.0	23	75.15	8.67	82.61
12.1-13.0	31	83.03	9.73	90.23
13.1-14.0	30	94.72	10.06	80.00
14.1-15.0	4	99.23	11.23	100
Total	91			
Eye diameter				
10.1-11.0	3	243.87	6.92	100.00
11.1-12.0	23	147.43	9.48	78.26
12.1-13.0	31	63.61	9.68	70.97
13.1-14.0	30	84.81	9.95	76.67
14.1-15.0	4	17.42	10.38	25.00
Total	91			
Head length				
10.1-11.0	3	44.64	21.17	33.33
11.1-12.0	23	54.25	25.52	78.26
12.1-13.0	31	78.32	27.82	83.87
13.1-14.0	30	24.78	29.46	70.00
14.1-15.0	4	5.20	32.44	75.00
Total	91			
Number of pectoral fin rays				
10.1-11.0	3	338.61	11.17	100
11.1-12.0	23	351.08	9.39	73.91
12.1-13.0	31	469.10	9.32	77.42
13.1-14.0	30	602.44	9.82	80.00
14.1-15.0	4	203.22	10.38	75.00
Total	91			

over the left side. The only exception is the pectoral fin ray count, which appears to be sinistral since counts on the left side are larger than those on the right side. For the pectoral fin ray count, bilateral asymmetry occurred in 78.02% of the total of 91 *P. longimanus* examined. The percentage of the left handed individuals is 46.2%. As to the preorbital, postorbital lengths, orbital diameter and head length, the bilateral asymmetry exhibited was 65.9%, 85.81%, 73.6% and 75.8% respectively. The percentages of the right handed specimens are, 38.5%, 49.5%, 35.7% and 38.9% respectively.

## DISCUSSION

*Pentaprion longimanus* is an active fish, subjected to greater energy demands. The energy is needed both for its developmental needs and environmental stress. Some energy is allocated for maintaining homeostasis (Mitton, 1994). If the available energy is not sufficient to buffer the stress effects, homeostasis may be impaired, resulting in abnormal development (Mitton, 1994; Somarakis *et al.*, 1997). Consequently, higher levels of asymmetry can be recorded in *P. longimanus*.

There is some variation in the asymmetry values among the five morphological characters studied in *P. longimanus*. Characters like pre and postorbital length and pectoral fin ray count showed higher asymmetry values than those of the other characters studied. High asymmetry values for these three characters have also been recorded in several freshwater and marine fish species (Al-Hassan *et al.*, 1990; Al-Hassan & Hassan, 1994; Jawad, 2001, 2003; Jawad *et al.*, 2010). Such agreements in results of asymmetry might indicate the vulnerability of these three characters to immediate changes in the environment. On the other hand, the low asymmetry values displayed in the two characters, head length and orbital diameter might be explained on the basis that these characters are designated with high functional importance and are highly canalized during ontogeny thus giving low level of fluctuating asymmetry, FA (Palmer & Strobeck, 1986; Moller & Pomiankowski, 1993).

The effect of asymmetry on the size of the fins, the body proportions of the fish and rendering the fish either left handed or right handed is evident from the results of some studies (Moodie & Reimchen, 1976; Reimchen, 1983; Cameron, 1995; Zygari *et al.*, 1999; Künzler & Bakker, 2000; Gonçalves *et al.*, 2002; Bergstrom & Reim-

chen, 2003). It is quite possible for such asymmetry to hinder the basic functions of those body parts.

In taxonomic and racial studies involving pectoral fin ray count and the pre and postorbital lengths, interchanging counts and differences in dimensions from left and right sides of *P. longimanus* introduce an additional source of variation to taxonomists who rely on these characters when separating specimens of this species or its populations. Bilateral asymmetry has proven problematic for fish taxonomists (Parenti, 1986) and taxonomists of animal groups other than fish such as owl (Norberg, 1977).

Pollution of sea water and sediments by hydrocarbons, heavy metals, pesticides and organic matter are considered the main cause of environmental stress (Bengtson & Hindberg, 1985). This state of pollution is not unusual for the coastal environment of the Oman Sea where different pollutants were reported to affect its waters in the last twenty years (De Mora *et al.*, 2004, 2005; Al-Darwish *et al.*, 2005; Tolosa *et al.*, 2005; Abdel Gawad *et al.*, 2008; Khan, 2008).

Several authors have shown a relationship between the coefficient of asymmetry and fish length (Al-Hassan *et al.*, 1990; Al-Hassan & Hassan, 1994; Al-Hassan & Shwafi, 1997; Jawad, 2001; Jawad *et al.*, 2010) where there was a trend of increase in the asymmetry value with the increase in fish length. This trend is probably the result of incomplete development; character means are always lowest in smaller size classes (Valentine *et al.*, 1973). The same results were obtained by Valentine *et al.* (1973) in selected fish species collected from California, U.S.A. and Jawad *et al.* (2010) in the carangid fish species, *Decapterus russelli* collected from the northern coastal region of the Oman Sea, Oman. The researchers suggested two possible hypotheses that may account for such a trend; namely, the ontogenetic changes (an increase in asymmetry with size - age) and the possible historical process (a secular increase in asymmetry).

## ACKNOWLEDGEMENT

We would like to thank the Ministry of Agriculture and Fisheries Wealth, the Agriculture and Fisheries Development Fund and the Marine Science and Fisheries Centre for giving us the opportunity to work on the fish samples within the qualitative and quantitative distribution of marine organisms in Sultanate of Oman and for providing the appropriate financial support.

# PREDHODNA ŠTUDIJA ASIMETRIJE MORFOLOŠKIH ZNAKOV PRI VRSTI *PENTAPRION LONGIMANUS* (OSTEICHTHYES: GERRIDAE) IZ OMANSKEGA ZALIVA

Laith A. JAWAD & Juma M. AL-MAMRY

Marine Science and Fisheries Centre, Ministry of Agriculture and Fisheries Wealth, PO Box 427, Post Code 100, Muscat, Sultanate of Oman

E-mail: laith\_jawad@hotmail.com

Amal M. AL-HINAI & Maryam A. AL-RASHIDI

High Technical College, Muscat, Sultanate of Oman

Haithem K. AL-BUSAIDI

Marine Science and Fisheries Centre, Ministry of Agriculture and Fisheries Wealth, PO Box 427, Post Code 100, Muscat, Sultanate of Oman

## POVZETEK

Članek obravnava spremenljivost asimetrije pri vrsti *Pentaprion longimanus*, ocenjeno na podlagi števila plavutnic v trebušnih plavutih in meritev štirih telesnih morfoloških znakov, tj. preorbitalne razdalje, postorbitalne razdalje, premera očesa in dolžine glave na obeh straneh telesa 91 primerkov iz populacije *P. longimanus*, ujetih pri mestu Muscat v Omanskem zalivu. Kot mero za asimetrijo smo uporabili absolutno razliko v meritvah telesnih morfoloških znakov na vsaki strani telesa. Rezultati kažejo, da je pri preorbitalni in postorbitalni razdalji in številu plavutnic v trebušnih plavutih asimetrija večja kot pri drugih obravnavanih telesnih znakih. Pri preorbitalni in postorbitalni razdalji je bil opažen tudi trend večanja vrednosti asimetrije z večanjem dolžine ribe. Kot možen vzrok asimetrije pri tej vrsti bi lahko navedli različna onesnaževala in njihovo prisotnost na obravnavanem območju. Upoštevana je bila tudi možnost uporabe teh ugotovitev v prihodnjih taksonomskih študijah vrste *P. longimanus*.

**Ključne besede:** spremenljiva asimetrija (FA), Omanski zaliv, Sultanat Oman, *Pentaprion longimanus*, indikator

## REFERENCE

- Abdel Gawad, E. A., M. Al-Azab & M. M. Lotfy (2008): Assessment of organic pollutants in coastal sediments, UAE. *Environ. Geol.*, 54, 1091–1102.
- Al-Abdessalaam, T. Z. S. (1995): Marine species of Sultanate of Oman. Marine Science and Fisheries Centre, Ministry of Fisheries Wealth, Oman, 412 p.
- Al-Darwish, H. A., E. A. Abd El-Gawad, F. H. Mohammed & M. M. Lotfy (2005): Assessment of organic pollutants in the offshore sediments of Dubai, United Arab Emirates. *Environ. Geol.*, 48, 531–542.
- Al-Hassan, L. A. J. & S. S. Hassan (1994): Asymmetry study in *Mystus pelusius* collected from Shatt al-Arab River, Basrah, Iraq. *Pak. J. Zool.*, 26, 276–278.
- Al-Hassan, L. A. J. & N. A. A. Shwafi (1997): Asymmetry analysis in two marine teleost fishes collected from the Red Sea coast of Yemen. *Pak. J. Zool.*, 29, 23–25.
- Al-Hassan, L. A. J., A. Y. Al-Doubaikeel, N. K. Wahab & N. K. Al-Daham (1990): Asymmetry analysis in the catfish, *Heteropneustes fossilis* collected from Shatt al-Arab River, Basrah, Iraq. *Riv. Idrobiol.*, 29, 775–780.
- Bengtson, B. E. & M. Hindberg (1985): Fish deformities and pollution in some Swedish waters. *Ambio*, 14, 32–35.
- Bergstrom, C. A. & T. E. Reimchen (2003): Asymmetry in structural defences: insights into selective predation in the wild. *Evolution*, 57, 2128–2138.
- Cameron, D. A. (1995): Asymmetric retinal growth in the adult teleost green sunfish (*Lepomis cyanellus*). *Vis. Neurosci.*, 12, 95–102.
- De Mora, S., S. W. Fowler, E. Wyse & S. Azemard (2004): Distribution of heavy metals in marine bivalve, fish and coastal sediments in the Gulf and Gulf of Oman. *Mar. Pollut. Bull.*, 49, 410–424.
- De Mora, S., S. W. Fowler, I. Tolosa, J.-P. Villeneuve & C. Cattini (2005): Chlorinated hydrocarbons in marine biota and coastal sediments from the Gulf and Gulf of Oman. *Mar. Pollut. Bull.*, 50, 835–849.
- Eriksen, M. S., Á. M. Espmark, T. Poppe, B. O. Braastad, R. Salte & M. Bakken (2008): Fluctuating asymmetry in farmed Atlantic salmon (*Salmo salar*) juveniles: also a maternal matter? *Environ. Biol. Fish.*, 81, 87–99.

**Fish Statistics (2010):** Fisheries statistic. Ministry of Agriculture and Fisheries Wealth, Muscat, Sultanate of Oman, 220 p.

**Froese, R. & D. Pauly (eds.) (2010):** FishBase. World Wide Web electronic publication. Available at [www.fishbase.org](http://www.fishbase.org) (version 07/2010).

**Gonçalves, D. M., P. C. Simões, A. C. Chumbinho, M. J. Correia, T. Fagundes & R. F. Oliveira (2002):** Fluctuating asymmetries and reproductive success in the peacock blenny. *J. Fish Biol.*, 60, 810–820.

**Jawad, L. A. (2001):** Preliminary asymmetry analysis of some morphological characters of *Tilapia zilli* (Pisces: Cichlidae) collected from three localities in Libya. *Boll. Mus. reg. Sci. nat. Torino*, 18(1), 251–257.

**Jawad, L. A. (2003):** Asymmetry in some morphological characters of four sparid fishes from Benghazi, Libya. *Oceanol. Hydrobiol. Stud.*, 32, 83–88.

**Jawad, L. A., J. M. Al-Mamry, A. A. Al-Kharusi & S. H. Al-Habsi (2010):** Asymmetry in certain morphological characters of the carangid species *Decapterus russelli*, collected from Lemah coastal area, on the northern part of Oman Sea. *Oceanol. Hydrobiol. Stud.*, 39, 55–62.

**Khan, N. Y. (2008):** Integrated management of pollution stress in the Gulf. In: Abuzinada, A. H., H.-J. Barth, F. Krupp, B. Boer & Z. Al-Abdessalaam (eds.): *Protecting the Gulf's Marine Ecosystems from Pollution*. Birkhauser, Basel, pp. 57–92.

**Künzler, R. & T. C. M. Bakker (2000):** Pectoral fins and paternal quality in sticklebacks. *Proc. R. Soc. Lond. B*, 267, 999–1004.

**Mitton, J. B. (1994):** Enzyme Heterozygosity, Metabolism, and Developmental Stability. In: Markow, T. A. (ed.): *Developmental Instability and Evolutionary Implications*. Kluwer Academic Publishers, the Netherlands, pp. 49–68.

**Møller, A. P. & A. Pomiankowski (1993):** Punctuated equilibria or gradual evolution: fluctuating asymmetry and variation in the rate of evolution. *J. Theor. Biol.*, 61, 359–367.

**Moodie, G. E. E. & T. E. Reimchen (1976):** Phenetic variation and habitat differences in *Gasterosteus* populations of the Queen Charlotte Islands. *Can. Field-Nat.*, 90, 471–474.

**Norberg, R. A. (1977):** Occurrence and independent evolution of bilateral ear asymmetry in owls and implications on owl taxonomy. *Philos. Trans. R. Soc. Lond. B*, 280, 375–408.

**Palmer, A. R. & C. Strobeck (1986):** Fluctuating asymmetry: measurements, analysis and pattern. *Ann. Rev. Ecol. Syst.*, 17, 391–421.

**Parenti, L. R. (1986):** Bilateral asymmetry in phallostethid fishes (Atherinomorpho) with description of a new species from Sarawak. *Proc. Calif. Acad. Sci.*, 44, 225–236.

**Reimchen, T. E. (1983):** Structural relationships between spines and lateral plates in three spine stickleback (*Gasterosteus aculeatus*). *Evolution*, 37, 931–946.

**Somarakis, S., I. Kostikas & N. Tsimenides (1997):** Fluctuating Asymmetry in the Otoliths of Lawa Fish as an Indicator of Condition Conceptual and Methodological Aspects. *J. Fish Biol.*, 51, 30–38.

**Tolosa, I., S. J. De Mora, S. W. Fowler, J.-P. Ville-neuve, J. Bartocci & C. Cattini (2005):** Aliphatic and aromatic hydrocarbons in marine biota and coastal sediments from the Gulf and the Gulf of Oman. *Mar. Pollut. Bull.*, 50, 1619–1633.

**Valentine, D. W., M. E. Soule & P. Samollow (1973):** Asymmetry in fishes: a possible statistical indicator of environmental stress. *Fish. Bull.*, 71, 357–370.

**Zygar, C. A., M. J. Russell & D. Fernald (1999):** Notsotemporal Asymmetry during Teleost Retinal Growth: Preserving an Area of Specialization. *J. Neurobiol.*, 41, 435–442.

Short scientific article  
Received: 2011-10-25

UDK 591.9:597.535(262.32)

## ON THE RECORD OF THE MORAY EEL (*MURAENA HELENA* LINNAEUS, 1758) IN SLOVENIAN COASTAL WATERS (GULF OF TRIESTE, NORTHERN ADRIATIC)

Lovrenc LIPEJ

Marine Biology Station, National Institute of Biology, SI-6330 Piran, Fornače 41, Slovenia  
E-mail: lipej@mbss.org

Sašo MOŠKON

Harpha Sea d.o.o. Koper, SI-6000, Koper, Čevljarska 8, Slovenia

### ABSTRACT

*The authors report on the record of the moray eel (*Muraena helena*) in Slovenian coastal waters (Gulf of Trieste, northern Adriatic). The specimen was caught by a diver with a speargun in June 2011. The moray eel measured 1,127 mm in total length and weighed 4,120 g. The estimated age of the moray eel was about 12 years. This is the first recorded case of the occurrence of moray eel in Slovenian waters.*

**Keywords:** moray eel, *Muraena helena*, first record, Gulf of Trieste

## PRIMA SEGNALAZIONE DI MURENA MEDITERRANEA (*MURAENA HELENA* LINNAEUS, 1758) IN ACQUE COSTIERE SLOVENE (GOLFO DI TRIESTE, ADRIATICO SETTENTRIONALE)

### SINTESI

*Gli autori riportano il ritrovamento della murena mediterranea (*Muraena helena*) nelle acque costiere slovene (Golfo di Trieste, Adriatico settentrionale). L'esemplare è stato catturato da un sommozzatore, con l'ausilio di un fucile subacqueo, nel giugno del 2011. La lunghezza totale della murena era pari a 1127 mm, per un peso di 4120 g. L'età dell'esemplare è stata valutata essere attorno ai 12 anni. Tale cattura è il primo ritrovamento di questa specie in acque slovene.*

**Parole chiave:** murena mediterranea, *Muraena helena*, prima segnalazione, Golfo di Trieste

## INTRODUCTION

The Mediterranean moray eel (*Muraena helena* Linnaeus, 1758) is one of three species of muraenids, known to occur in the Adriatic Sea. The second muraenid in the area is the brown moray *Gymnothorax unicolor*, which is a rare and less known fish in the whole Adriatic Sea (Tortonese, 1970; Jardas, 1996). The third muraenid species is a recently discovered non native species, the fangtoothed moray *Enchelycore anatina*, which was photographed in waters off two southern Adriatic islands (Lipej *et al.*, 2011). The Mediterranean moray eel is a subtropical, reef-associated resident species, living across the eastern Atlantic from south of the British Isles to Senegal, including the Mediterranean, the Azores, Madeira, the Canary and the Cape Verde Islands (Tortonese, 1970; Bauchot, 1986).

There is a lack of published data on the Mediterranean moray eel in the Adriatic Sea, but also in the Mediterranean as a whole (Matić-Skoko *et al.*, 2011). Jardas (1996) reported on the presence of the moray eel in the middle and southern Adriatic Sea, whereas in the northern part it is considered rare. In older checklists, *M. helena* was not recorded for the Gulf of Trieste (for example, Trois, 1875; Perugia, 1881; Stossich, 1881; Faber, 1883). In the “Key for identification of vertebrates in Slovenia” Marčeta (1999) did not mention this species among the vertebrates known to be recorded in Slovenia.

The aim of this paper is to present the first data on the occurrence of a single specimen of moray eel for the Slovenian coastal sea.



**Fig. 1: Map of the studied area with the locality, where the specimen of *Muraena helena* was caught.**

**Sl. 1: Zemljevid obravnavanega območja, kjer je bil ujet primerek murene (*Muraena helena*).**

## MATERIAL AND METHODS

A diver caught the moray eel with a speargun while shore diving on 18 June 2011 in the early morning hours. The speargun was equipped with the Panasonic DMC-FT2 camera. The diver sighted the moray eel at 6.7 m of depth on a rocky bottom off the town of Piran (Fig. 1). The habitat where the moray eel was caught is characterized by sandstone boulders covered mainly with sponges and colonies of the Mediterranean stony coral *Cladocora caespitosa*. The surroundings of the moray eel hole were almost completely covered with sponges *Verongia aerophoba* and *Chondrilla nucula*. At the time of capture, the moray eel was emerging its head out of the vertical hole. The diameter of the hole was estimated to measure 12 cm. The diver erroneously thought that the fish was a European conger *Conger conger* Linnaeus, 1758, which is a rather common anguilliform species in the area. After the capture, the specimen was photographed and measured with a hand meter to the nearest millimetre and weighed to the nearest gram.

## RESULTS AND DISCUSSION

The specimen of moray eel (Figs. 2, 3) was determined due to typical diagnostic characters. The body was elongated and typical anguilliform. The dorsal fin began behind its head and extended to the caudal fin. The pelvic and pectoral fins were absent. The head was short and massive. The gill opening was reduced to a small lateral pore. The specimen exhibited a typical marbled colour pattern. The moray eel measured 1,127 mm in total length (TL) and weighed 4,120 g (Tab. 1). Since *Muraena helena* can range from 419 to 1,340 mm TL and weigh between 109 and 6,450 g (Jiménez *et al.*, 2007), the studied specimen could be considered as quite big. According to the length-at-age equation used

**Tab. 1: Biometric data for the specimen of *M. helena*.**

**Tab. 1: Biometrični podatki za primerek murene.**

Parameter	Length/weight	% of standard length
Standard length (mm)	1,127	100.00
Head length (mm)	136	12.07
Eye diameter (mm)	8	0.71
Preorbital length (mm)	23	2.04
Jaw length (mm)	55	4.88
Predorsal distance (mm)	121	10.74
Dorsal fin length (mm)	1,006	89.26
Anal fin length (mm)	542	48.09
Height at orbit (mm)	39	3.46
Height at gill opening (mm)	112	9.94
Weight (g)	4,120	

by Matić-Skoko *et al.* (2011), the estimated age derived from the total length and weight of our specimen would be 12 years. The same authors consider the life span to be around 15 years.

P. Kružić (*in litt.*) recorded this species at the island of Čutin. M. Kovačić (*pers. comm.*), the curator of marine ichthyofauna and other vertebrates in the Rijeka Natural History Museum, has never recorded this species during his ichthyological surveys in the Kvarner area. Up to date the moray eel has not been recorded off the western Istrian coast. However, A. Jaklin (Centre for Marine Research, Rovinj, *pers. comm.*) possesses an information about a small specimen of moray eel, found at a depth of 30 m close to the islet of Fraškera, south of the very tip of the Istrian peninsula.

The occurrence of the moray eel in Slovenian waters could be related to the northward spreading of southern species. As in many other regions, also in the Adriatic Sea the present-day sea warming ultimately favours the spreading of thermophilous fish species. Many cases of this phenomenon in the Adriatic Sea have already been pointed out by various studies (Dulčić *et al.*, 1999; Lipelj & Dulčić, 2004). Such indicator fish species, which



**Fig. 3: A close photo of the head of moray eel. (Photo: S. Moškon).**

**Sl. 3: Bližinski posnetek glave murene. (Foto: S. Moškon).**

were able to reach the southern tip of the Istrian peninsula, are for example *Thalassoma pavo* (P. Kružić, *pers. comm.*) and *Sphoroides pachygaster* (Dulčić, 2002). Certain fish species which could be related to the northward spreading and have recently been confirmed in the Slovenian part of the Adriatic Sea are *Coryphaena hippurus* (Dulčić & Lipelj, 1997) and *Pomatomus saltator*. The later was caught in great numbers in spring 2011 at the mouth of the Dragonja River.

The moray eel in Slovenian coastal waters probably arrived from waters off the western Istrian peninsula. The possibility that the moray eel has simply been overlooked in the area is to our opinion less realistic. In fact, in the period from 1999 to 2011 there were regular faunistic surveys, especially visual census techniques, performed in the studied area. Additionally, we cannot completely disregard the possibility of an intentional release of aquarium specimens in the marine ecosystem. Only in the nearby future we will be able to ascertain whether this case of the moray eel should be considered as a rather exceptional one or should it be attributed to a spreading of moray eel range extension.

#### ACKNOWLEDGMENTS

Authors wish to express their gratitude to Valter Žiža, Iztok Škornik, Dr. Marcelo Kovačić, Dr. Petar Kružić, Dr. Andrej Jaklin, Roberto Odorico, Nicola Bettoso, Dr. Tom Turk, Borut Furlan and other colleagues who shared with us their information regarding the occurrence of the moray eel in the Adriatic Sea. Special thanks also goes to Dr. Sanja Matić-Skoko for her precious help, useful scientific literature and her knowledge on muraenids which she shared with us.



**Fig. 2: 1,127 mm long specimen of *M. helena*, caught in waters off Piran (Gulf of Piran). (Photo: S. Moškon)**

**Sl. 2: 1127 mm dolg primerek murene, ujete v vodah blizu Pirana (Piranski zaliv). (Foto: S. Moškon)**

## O POJAVLJANJU MURENE (*MURAENA HELENA* LINNAEUS, 1758) V SLOVENSKIH OBALNIH VODAH (TRŽAŠKI ZALIV, SEVERNI JADRAN)

Lovrenc LIPEJ

Morska biološka postaja, Nacionalni inštitut za biologijo, SI-6330 Piran, Fornače 41  
E-mail: lipej@mbss.org

Sašo MOŠKON

Harpha Sea d.o.o. Koper, SI-6000, Koper, Čevljarska 8

### POVZETEK

*Avtorja poročata o pojavljanju murene (Muraena helena) v slovenskih obalnih vodah (Tržaški zaliv, severni Jadrán). Primerek je ujel potapljač s podvodno puško junija 2011. Murena je v celotno dolžino merila 1127 mm in tehta 412 g. Ocenjena starost primerka je 12 let. To je prvi zabeležen primer pojavljanja murene v slovenskih vodah.*

**Ključne besede:** murena, *Muraena helena*, prva najdba, Tržaški zaliv

### REFERENCES

- Bauchot, M.-L. (1986):** Muraenidae. In: Whitehead, P. J. P., M.-L. Bauchot, J.-C. Hureau, J. Nielsen & E. Tortonese (eds.): Fishes of the North-eastern Atlantic and the Mediterranean, Vol. 2. UNESCO, Paris, pp. 537-544.
- Dulčić, J. (2002):** Northernmost occurrence of *Spherooides pachygaster* (Tetraodontidae) in the Adriatic Sea. Bull. Mar. Sci., 70, 133-139.
- Dulčić, J. & L. Lipej (1997):** New records of marine fishes from the Slovenian coastal waters. Falco, 11(12), 35-40.
- Dulčić, J., B. Grbec, & L. Lipej (1999):** Information on the Adriatic ichthyofauna-effect of water warming? Acta Adriat., 40, 33-43.
- Faber, G. L. (1883):** The fisheries of the Adriatic and the fish thereof: a report of the Austro-Hungarian sea-fisheries with a detailed description of the marine fauna of the Adriatic Gulf. Bernard Quaritch, Piccadilly, London, 328 p.
- Jardas, I. (1996):** Jadranska ihtiofavna. Školska knjiga, Zagreb, 533 p.
- Jiménez, S., S. Schönhuth, I. J. Lozano, J. A. González, R. G. Sevilla, A. Diez & J. M. Bautista (2007):** Morphological, ecological, and molecular analyses separate *Muraena augusti* from *Muraena helena* as a valid species. Copeia, 2007(1), 101-113.
- Lipej, L. & J. Dulčić (2004):** The current status of Adriatic fish biodiversity. In: Griffiths, H. I., B. Kryštufek & J. M. Reed (eds.): Balkan biodiversity: pattern and process in the European hotspot. Kluwer Academic, Dordrecht, London, pp. 291-306.
- Lipej, L., B. Furlan, N. Antolović, D. Golani & J. Dulčić (2011):** The first record of fangtooth moray *Enchelycore anatina* (Lowe, 1839) in the Adriatic Sea. J. Appl. Ichthyol., 27, 1387-1389.
- Marčeta, B. (1999):** Osteichthyes. In: Kryštufek, B. & F. Janžekovič (eds.): Key for determination of vertebrates in Slovenia. DZS, Ljubljana, pp. 47-210. (In Slovenian)
- Matić-Skoko, S., P. Tutman, M. Petrić, D. Skaramuca, D. Đikić, D. Lisičić & B. Skaramuca (2011):** Mediterranean moray eel *Muraena helena* (Pisces: Muraenidae): biological indices for life history. Aquat. Biol., 13, 275-284.
- Perugia, A. (1881):** Elenco sistematico degli animali del Mare Adriatico. Ulrico Hoepli Editore, Milano.
- Stossich, M. (1881):** Prospetto della Fauna del Mare Adriatico. Boll. Soc. Adr. Sci. nat. Trieste, 5, 1-236.
- Tortonese, E. (1970):** Osteichthyes (Pesci Ossei). Parte Prima. Fauna d'Italia, Vol. X. Calderini, Bologna, 565 p.
- Trois, E. F. (1875):** Prospetto sistematico dei pesci dell'Adriatico e catalogo della collezione ittologica del R. Istituto Veneto Atti R. Ist. Ven. Sc. Let. ed Arti, (Ser. V) 1, 1-46.

Short scientific article  
Received: 2011-10-03

UDK 591.159:597.556.221.1(262.26)

MORPHOLOGICAL ABNORMALITIES IN THE ANNULAR SEA BREEM  
*DIPLodus ANNULARIS* (OSTEICHTHYES: SPARIDAE)  
FROM THE LAGOON OF BIZERTE (NORTHEASTERN TUNISIA,  
CENTRAL MEDITERRANEAN)

Nour El Houda KHENFECH & Moncef BOUMAÏZA

Laboratoire d'Hydrobiologie Littorale et Limnique, Université du 07 novembre à Carthage, Faculté des Sciences, Zarzouna, 7021  
Bizerte, Tunisia

Christian REYNAUD & Christian CAPAPÉ

Laboratoire interdisciplinaire de Recherche sur la Didactique, l'Éducation et la Formation, E. A. 3749, case 77, Université Montpellier  
II, Sciences et Techniques du Languedoc, 34095 Montpellier cedex 5, France  
E-mail: capape@univ-montp2.fr

ABSTRACT

*Morphological abnormalities observed in annular sea bream *Diplodus annularis* (Linnaeus, 1758) collected in the Lagoon of Bizerte (northern Tunisia), such as abnormal body shape, skeletal deformities and a reduced anal fin are presented in this paper. The origins of these abnormalities are commented and discussed.*

**Key words:** lateral line, vertebral column, hyperkyphosis, scale, environmental pollution

ANORMALITÀ MORFOLOGICHE IN SARAGO SPARAGLIONE *DIPLodus ANNULARIS*  
(OSTEICHTHYES: SPARIDAE) DELLA LAGUNA DI BIZERTE (TUNISIA NORD-ORIENTALE,  
MEDITERRANEO CENTRALE)

SINTESI

*Diverse anomalie morfologiche sono state osservate in esemplari di sarago sparaglione *Diplodus annularis* (Linnaeus, 1758), catturati nella Laguna di Bizerte (Tunisia settentrionale). Nell'articolo vengono presentate deformità scheletriche, forme corporee anormali e pinne anali ridotte. L'origine di tali anomalie morfologiche viene commentata e discussa.*

**Parole chiave:** linea laterale, colonna vertebrale, ipercifosi, scaglie, inquinamento ambientale

## INTRODUCTION

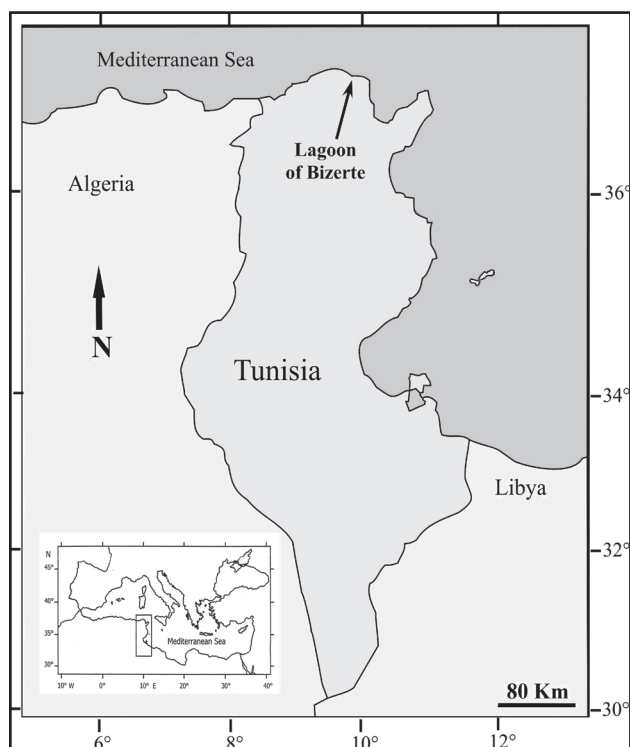
According to Bradai (2000), at least 21 sparid species, all economically important, are commonly collected all along the Tunisian coast (Fig. 1); some of them enter brackish areas, such as the Bahiret El Biban in the south and the Lagoon of Bizerte in the north, where they live and reproduce. Sustainable populations, established in the Lagoon of Bizerte (Fig. 2), are targeted by fishermen throughout the year. Sparid production of the area ranges between 2.8% and 7.7% of the total production of sparids for Tunisian waters with mean  $4.8 \pm 1.5\%$  (Anonymous, 2008). During investigations conducted in the area since 2006, focusing primarily on elasmobranch species (El Kamel *et al.*, 2009a, b), an annular sea bream exhibiting morphological deformities was captured. Comprehensive bibliographies of recorded abnormalities in teleost species did not report any case in *Diplodus annularis* (see Dawson, 1964, 1966, 1971; Dawson & Heal, 1971; Jawad & Hosie, 2007; Jawad *et al.*, 2010). The aim of this note is therefore to describe an abnormal specimen and comment on similar abnormalities previously observed in teleost species. Additionally, we try to explain the cause of such deformities in a specimen captured in a restricted area submitted to

intense pollution. The role of pollution on fish species and consequently on fishery production could constitute one of the most important pieces of information for improving fishery monitoring and management in the study area.

## MATERIAL AND METHODS

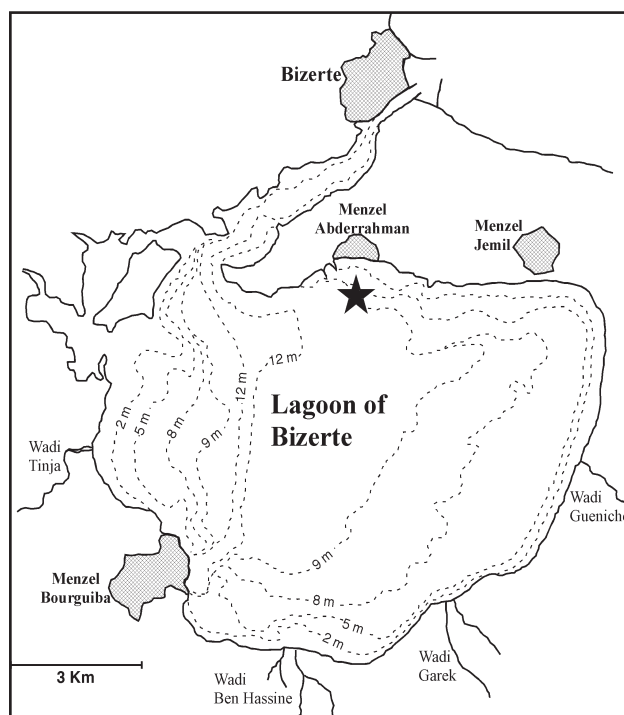
On 15 August 2010, one annular sea bream presenting an abnormal body shape was collected in the northern region of the Lagoon of Bizerte, off Menzel Abderrahman, ( $37^{\circ}13'31.34''$  N,  $9^{\circ}50'28.79''$  E), with commercial gill-net, having 26 mm of mesh size, at a depth of 9 m approximately, on sandy-muddy bottom, with other annular sea breams (Fig. 2).

The fresh specimen was measured to the nearest mm and weighed to the nearest gram. Eviscerated mass, liver mass and gonad mass were also recorded, the stomach content was removed, sorted, weighed and prey items identified whenever possible. Morphometric measurements and meristic counts followed Bauchot & Hureau (1986); they were recorded in the abnormal specimen and compared with those recorded in 3 normal specimens (Tab. 1). Twelve scales were removed from the lateral line of the abnormal specimen and a normal



**Fig. 1:** Map of the Mediterranean Sea showing the Tunisian coast and map of Tunisia showing the location of the Lagoon of Bizerte.

**Sl. 1:** Zemljevid Sredozemskega morja s tunizijsko obalo in zemljevid Tunizije z označeno Laguno Bizerte.



**Fig. 2:** Map of the Lagoon of Bizerte, showing the capture site (black star) of the abnormal *Diplodus annularis* (FSB-Dip-ann. 01).

**Sl. 2:** Zemljevid Lagune Bizerte z označeno točko ulova (črna zvezda) abnormalnega primerka *Diplodus annularis* (FSB-Dip-ann. 01).

specimen, and measured from the anterior edge to the posterior edge to the nearest 0.001 mm, by micrometric calliper under binocular microscope.

Some specimens used in this paper were preserved in 10% buffered formalin and deposited in the Ichthyological Collection of the Faculté des Sciences of Bizerte

(Tunisia), receiving the catalogue numbers: FSB-Dip-ann 01 for the abnormal specimen, and FSB-Dip-ann 02, FSB-Dip-ann 03, FSB-Dip-ann 04, for the 3 normal specimens, respectively. To study the relationship total length (TL, in mm) vs. total mass (TM, in g), 21 specimens were used including the abnormal specimen.

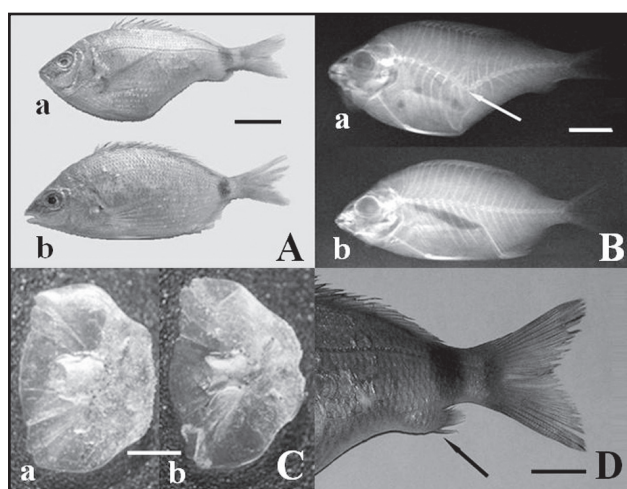
**Tab. 1: Morphometric measurements and meristic counts recorded in the abnormal *Diplodus annularis* (FSB-Dip-ann. 01), and 3 normal *D. annularis* (FSB-Dip-ann. 02. 03 and 04).**

**Tab. 1: Morfometrični in meristični podatki za abnormalen primerek *Diplodus annularis* (FSB-Dip-ann. 01), in 3 normalne primerke *D. annularis* (FSB-Dip-ann. 02. 03 in 04).**

Reference	FSB-Dip-ann01		FSB-Dip-ann 02		FSB-Dip-ann 03		FSB-Dip-ann04	
Weight (g)	45.7		35.9		32.9		37.5	
Morphometric counts	mm	% SL	mm	% SL	mm	% SL	mm	% SL
Total length	138	120.0	134	114.5	135	120.2	136	119.3
Standard length	115	100.0	117	100.0	113	100.0	114	100.0
Anal fin base	3	2.9	23	19.8	25	22.8	24	21.4
Body depth at anal fin origin	17	14.9	40	34.5	41	36.8	36	31.6
Width at anal fin origin	8	7.3	13	11.2	12	11.2	11	10.0
Maximum body width	15	13.3	14	12.4	13	12.2	12	10.6
Anal fin length	10	8.9	31	26.5	30	26.7	31	27.5
Caudal fin length	26	22.9	26	22.8	25	23.1	25	22.4
Caudal peduncle length	10	9.1	9	8.3	9	8.8	9	8.1
Caudal peduncle depth	4	3.3	3	3.2	3	3.2	3	3.1
Dorsal fin base	48	42.1	54	46.7	57	51.0	56	49.6
Cheek depth	11	9.7	11	9.5	10	9.3	9	8.4
Head length	30	26.3	30	25.9	30	27.2	31	27.2
Head width	17	15.6	14	12.4	14	12.8	13	11.7
Eye diameter	4	3.6	4	3.9	4	3.6	3	3.4
Interorbital width	8	7.1	7	6.7	7	6.8	8	7.4
Postorbital length	18	16.3	19	16.7	19	17.3	19	17.4
Pectoral fin length	34	30.3	38	33.2	37	33.3	38	34.1
Length of pelvic fin	24	21.2	23	20.3	22	20.2	25	22.4
Snout length	14	12.7	12	10.5	11	10.6	12	10.8
Distance from snout to anal fin origin	88	77.2	70	60.1	70	62.4	68	60.3
Distance from snout to anus	47	41.1	64	54.7	63	56.3	62	54.9
Distance from snout to dorsal fin origin	37	32.5	35	30.1	36	32.2	39	34.4
Distance from snout to pelvic fin origin	32	28.3	36	31.4	37	33.6	37	33.1
Distance from pelvic fin origin to anus	19	17.1	28	24.8	28	25.1	25	22.3
Body depth at pelvic fin origin	15	13.9	14	12.6	13	11.7	13	11.8
Meristic counts	FSB-Dip-ann01		FSB-Dip-ann 02		FSB-Dip-ann 03		FSB-Dip-ann04	
Dorsal fin rays	XI + 11		XI + 11		XI + 11		XI + 11	
Pectoral fin rays	11		12		11		12	
Pelvic fin rays	I + 5		I + 5		I + 5		I + 5	
Anal fin rays	6		III + 11		III + 11		III + 11	
Caudal fin rays	18		16		16		16	
Scales in lateral line	54		46		46		45	
Scales in transversal line	21		18		20		18	

## RESULTS AND DISCUSSION

The abnormal *Diplodus annularis* exhibited an irregular and sinuous lateral line (Fig. 3A, a), while in normal specimens it is regular and curved at pectoral fin level (Fig. 3A, b). The specimen was photographed with soft X-rays in order to point out a potential correlation between lateral line and osteological malformations (Fig. 3B). The abnormal specimen presented hyperkyphosis, defined as an exaggerated curvature of the vertebral column at the thoracic region level (Fig. 3B, a), with vertebrae fused and apparently less developed than those observed in the normal specimen (Fig. 3B, b). The number of scales of the lateral line, 54, was higher in the abnormal specimen than



**Fig. 3:** (A) *Diplodus annularis*, both specimens were caught in the lagoon of Bizerte, scale bar 25 mm; a - abnormal specimen (FSB-Dip-ann. 01); b - normal specimen (FSB-Dip-ann. 02). (B) X-Ray photograph of *D. annularis*, scale bar 20 mm; a - abnormal specimen (FSB-Dip-ann. 01) with arrow pointing out the hyperkyphosis of the vertebral column; b - normal specimen (FSB-Dip-ann. 02). (C) Scales of lateral line removed from *D. annularis*, scale bar 1 mm; a - abnormal specimen (FSB-Dip-ann. 01); b - normal specimen (FSB-Dip-ann. 02). (D) Terminal region of the abnormal *D. annularis* (FSB-Dip-ann. 01), arrow showing the reduced anal fin, scale bar 20 mm.

**Sl. 3:** (A) *Diplodus annularis*, oba primerka ulovljena v Laguni Bizerte, merilo 25 mm; a - abnormalen primerk (FSB-Dip-ann. 01); b - normalen primerk (FSB-Dip-ann. 02). (B) Rentgenski posnetek *D. annularis*, merilo 20 mm; a - abnormalen primerk (FSB-Dip-ann. 01), puščica kaže na hiperkifoza hrbtnice; b - normalen primerk (FSB-Dip-ann. 02). (C) Luske s pobočnice *D. annularis*, merilo 1 mm; a - abnormalen primerk (FSB-Dip-ann. 01); b - normalen primerk (FSB-Dip-ann. 02). (D) Zadnji del abnormalnega primerka *D. annularis* (FSB-Dip-ann. 01), puščica kaže na zmanjšano podrepno plavut, merilo 20 mm.

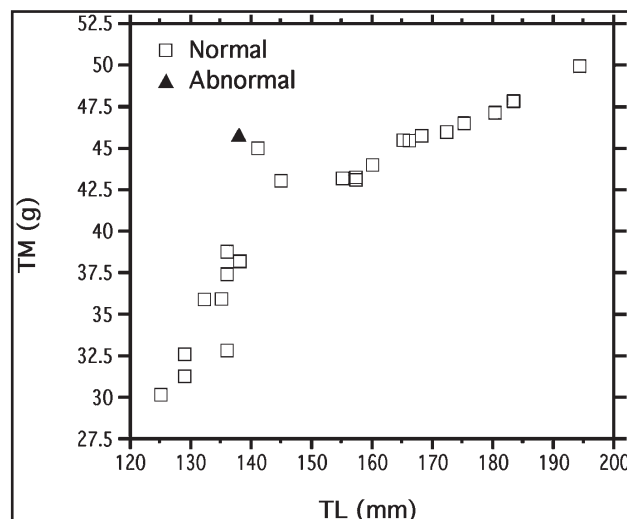
in 3 other normal ones, all having 46 scales. Such difference was probably due to the fact that the sinuous lateral line was relatively longer in the abnormal specimen (Tab. 1). Additionally, scales of lateral line removed from each specimen were not morphologically different, but significantly smaller in the abnormal specimen (paired *t*-test,  $t = 4.31$ ,  $df = 11$ ,  $p = 0.007$ ), and consequently more numerous (Fig. 3C, a, b). The anterior belly of the abnormal specimen was hyper developed as an effect of the deformed vertebral column, while the posterior region was strongly reduced, especially in the terminal part. The anal fin of the abnormal specimen was considerably reduced; it was smaller than that of the normal specimen, representing 8.9% SL in the former and 26.5-27.7% SL in the latter, respectively (Tab. 1). Additionally, the pterygiophore supporting the anal fin lacked, no spinous ray was found; only 6 soft rays were counted in the anal fin of the abnormal specimen while all normal specimens had 11 soft rays in the anal fin (Tab. 1, Fig. 3D).

Lateral line deformation and scale deformity were the result of irregular scalation, mechanical dysfunction in ontogeny, and probably environmental and genetic factors according to Jawad *et al.* (2006-2007). They could also be due to skeletal malformation, as observed in the present specimen having a hyperkyphosis; similar patterns were reported by Jardas & Homen (1977) in the whiting *Merlangius merlangus* (Linnaeus, 1758) and the bogue *Boops boops* (Linnaeus, 1758). Jardas & Homen (1977) added that such anomalies were not very rare in teleost species from the Adriatic, and suggested that parasitic infection could be also the cause of skeletal deformations.

Jawad *et al.* (2010) noted that anomaly in fins could hinder the performance of the specimen especially its capacity to get food and to avoid predators. In the case presented herein, the observed deformities did not affect the life of the abnormal specimen which lived and developed in the wild as other normal specimens of the same size class, as shown by the relation between TL vs. TM plotted in Fig. 4, with  $TM = 0.267 TL + 0.579$ ;  $r = 0.827$ . Similar patterns were observed by Al-Mamry *et al.* (2010) in silver pomfrets *Pampus argenteus* (Euphrasen, 1788). In contrast, Matsuoaka (1987) and Bogliione *et al.* (2006) noted a lethal effect caused by severe skeletal deformities in teleost species living in natural conditions. Similar patterns concerning fin absence, reduction of fin, or abnormal fin were listed by Dawson (1964, 1966, 1971) and Dawson & Heal (1971). Biotic factors such as an attack of aquatic organisms cannot be totally excluded (Dulčić & Soldo, 2005), even if it did not concern the studied specimen.

Abnormalities in fish species occur during the early stages of development and could constitute an important indicator on unfavourable environmental conditions and pollutants, induced stress in the wild (Sfakianakis *et al.*, 2004). Heavy metals such as Cd, Pb, Zn and Cu are suspected to cause reduction or absence of fins (Sloof,

1982), vitamin C deficiency has been associated with caudal fin degeneration (Havler, 1972). Several cases of abnormalities were described in animal species collected in the Lagoon of Bizerte, a restricted brackish area polluted by both inorganic and organic nutrients and heavy metals (Mzoughi et al., 2002). Such pollution could explain the specimens of *Torpedo torpedo* from the Lagoon of Bizerte presenting abnormalities (Ben Brahim & Capapé, 1997; Ben Brahim et al., 1998; El Kamel et al., 2009b; Mnasri et al., 2010; El Kamel-Moutalibi et al., 2011). The common torpedo lives buried in sandy bottoms, where pollutants are accumulated. Louiz et al. (2007) noted that skeletal deformities observed in 3 gobiid species were significantly higher in the severely polluted areas. Additionally, gastropods are collected in the area, such as the purple dye murex *Bolinus brandaris* (Linnaeus, 1758) and the banded dye murex *Hexaplex trunculus* (Linnaeus, 1758). Both species, at present, exhibit the development of imposex in females, a phenomenon linked to the use of organic biocides, such as tributyltin, the consequence of environmental pollution (Abidli et al., 2008). The annular sea bream described in this note probably constitutes a new instance of abnormality induced by environmental pollution in the Lagoon of Bizerte.



**Fig. 4: Relationship total length (TL) vs. total mass (TM) in 21 specimens of *Diplodus annularis* collected in the Lagoon of Bizerte.**

**Sl. 4: Razmerje celotna dolžina (TL) vs. celotna masa (TM) 21 primerkov *Diplodus annularis*, ulovljenih v Laguni Bizerte.**

## MORFOLOŠKE NEPRAVILNOSTI PRI ŠPARU *DIPLODUS ANNULARIS* (OSTEICHTHYES: SPARIDAE) IZ LAGUNE BIZERTE (SEVEROVZHODNA TUNIZIJA, OSREDNJE SREDOZEMLJE)

Nour El Houda KHENFECH & Moncef BOUMAÏZA

Laboratoire d'Hydrobiologie Littorale et Limnique, Université du 07 novembre à Carthage, Faculté des Sciences, Zarzouna, 7021 Bizerte, Tunisia

Christian REYNAUD & Christian CAPAPÉ

Laboratoire interdisciplinaire de Recherche sur la Didactique, l'Éducation et la Formation, E. A. 3749, case 77, Université Montpellier II, Sciences et Techniques du Languedoc, 34095 Montpellier cedex 5, France  
E-mail: capape@univ-montp2.fr

### POVZETEK

Članek obravnava morfološke nepravilnosti pri šparu *Diplodus annularis* (Linnaeus, 1758), ulovljenem v Laguni Bizerte (severna Tunizija), npr. nepravilno obliko telesa, deformacije skeleta in zmanjšano podrepno plavut, ter možne izvore teh nepravilnosti.

**Ključne besede:** pobočnica, hrbtnica, hiperkifoza, luska, okoljsko onesnaženje

## REFERENCES

- Abidli, S., Y. Lahbib & N. Trigui El Ménif (2008):** Effects of tributyltin (Tbt) on the imposex development in two gonochoristic Neogastropods: *Bolinus brandaris* and *Hexaplex trunculus* collected in the Lagoon of Bizerte (Tunisia). International Conference on Monitoring & Modelling of Marine Pollution. Book of Abstracts. 1-3 December 2008, Kish Island, Islamic Republic of Iran, pp. 89.
- Al-Mamry, J. M., L. A. Jawad, I. H. Al-Rasady & S. H. Al-Habsi (2010):** First record of dorsal and anal fin deformities in silver pomfrets, *Pam. upas argenteus* (Stromateida, Actinopterygii). *An. Biol.*, 32, 73-77.
- Anonymous (2008):** Annuaire des statistiques des produits de la pêche en Tunisie, Direction Générale à la Pêche et à l'Aquaculture (DGPA). Ministère de l'Agriculture et des Ressources Hydrauliques (M.A.R.H), 800 p.
- Bauchot, M.-L. & C. Hureau (1986):** Sparidae. In: Whitehead, J. P., M. L. Bauchot, J. C. Hureau, J. Nielsen & E. Tortonese (Eds.): Fishes of the North-western Atlantic and the Mediterranean, Vol. II. UNESCO, Paris, pp. 883-907.
- Ben Brahim, R. & C. Capapé (1997):** Nageoire dorsale supplémentaire chez une torpille ocellée, *Torpedo (Torpedo) torpedo* des eaux tunisiennes (Méditerranée Centrale). *Cybium*, 21(2), 223-225.
- Ben Brahim, R., A. A. Seck & C. Capapé (1998):** Albinisme chez la torpille ocellée, *Torpedo (Torpedo) torpedo* (Linnaeus, 1758). *Cybium*, 22(1), 83-86.
- Boglione, C., C. Costa, M. Giganti, M. Cecchenetti, P. Di Dato, M. Scardi & S. Cataudella (2006):** Biological monitoring of wild thicklip grey mullet (*Chelon labrosus*), golden grey mullet (*Liza aurata*) and fathead mullet (*Mugil cephalus*) (Pisces: Mugilidae) from different Adriatic sites: meristic counts and skeletal anomalies. *Ecol. Indic.*, 6, 712-732.
- Bradaï, M. N. (2000):** Diversité du peuplement ichthyique et contribution à la connaissance des sparidés du golfe de Gabès. Ph.D. Thesis. University of Sfax, Tunisia, 600 p.
- Dawson, C. (1964):** A bibliography of anomalies of fishes. *Gulf Res. Rep.*, 1, 308-399.
- Dawson, C. (1966):** A bibliography of anomalies of fishes. *Gulf Res. Rep.*, 2, 169-176.
- Dawson, C. (1971):** A bibliography of anomalies of fishes. *Gulf Res. Rep.*, 3, 215-239.
- Dawson, C. & F. Heal (1971):** A bibliography of anomalies of fishes. *Gulf Res. Rep.*, suppl. 3, 215-239.
- Dulčić, J. & A. Soldo (2005):** Absence of caudal fin in *Solea solea* (Soleidae) collected in the Northern Adriatic. *Cybium*, 29, 308-309.
- El Kamel, O., N. Mnasri, J. Ben Souissi, M. Boumaïza, M. M. Ben Amor & C. Capapé (2009a):** Inventory of elasmobranch species caught in the Lagoon of Bizerte (north-eastern Tunisia, central Mediterranean). *PANAM-JAS*, 4(4), 383-412.
- El Kamel, O., N. Mnasri, M. Boumaïza & C. Capapé (2009b):** Atypical abnormality in a common torpedo, *Torpedo torpedo* (Chondrichthyes: Torpedinidae) from the Lagoon of Bizerte (northern Tunisia, central Mediterranean). *Cah. Biol. Mar.*, 50(1), 97-101.
- El Kamel-Moutalibi, O., N. Mnasri, M. Boumaïza, C. Reynaud & C. Capapé (2011):** Abnormalities in common torpedos, *Torpedo torpedo* (Chondrichthyes: Torpedinidae) from the Lagoon of Bizerte (Northern Tunisia, Central Mediterranean). *Annales, Ser. Hist. Nat.*, 21(2), 135-142.
- Havler, J. E. (1972):** The role of ascorbic acid in fish disease and tissue repair. *Bull. Jpn. Soc. Sci. Fish.*, 38, 79-93.
- Jardas, I. & Z. Homen (1977):** Nouvelles trouvailles sur les anomalies anatomiques des exemplaires tératologiques des poissons adriatiques. *Biljeske-Notes*, 34, 1-10.
- Jawad, L. A. & A. Hosie (2007):** On the record of pugheadedness in snapper, *Pagrus auratus* (Forster 1801) (Perciformes, Sparidae) from New Zealand. *Acta Adriat.*, 48, 205-210.
- Jawad, L. A., S. T. Ah Yong, & A. Hosie (2006-2007):** Malformation of the lateral line and ambicolouration in the triplefin *Grahamina capito* (Jenyns 1842) (Pisces: Tripterygiidae) from New Zealand. *Ann. Mus. Civ. Stor. Nat. Ferrara*, 9-10, 89-97.
- Jawad, L. A., Z. Sadighzadeh & T. Valinassab (2010):** Malformation of the caudal fin in the freshwater mullet, *Liza abu* (Actinopterygii: Mugilidae) collected from Karkhe River, Iran. *An. Biol.*, 32, 11-14.
- Louiz, I., D. Menif, M. Ben Attia & O. M. Ben Hassine (2007):** Incidence des déformations squelettiques chez trois espèces de Gobiidae de la lagune de Bizerte (Tunisie). *Cybium*, 31(2), 199-206.
- Matsuoaka, M. (1987):** Development of skeletal tissue and skeletal muscle in the Red Sea bream, *Pagrus major*. *Bull. Seikai Reg. Fish. Res. Lab.*, 65, 1-102.
- Mnasri, N., O. El Kamel, M. Boumaïza, M. M. Ben Amor, C. Reynaud & C. Capapé (2010):** Morphological abnormalities in two batoid species (Chondrichthyes) from northern Tunisian waters (central Mediterranean). *Annales, Ser. Hist. Nat.*, 20(2), 181-190.
- Mzoughi, N., F. Hellal, M. Dachraoui, J.-P. Vileuneuve, C. Cattini, S. de Mora & A. El Abed (2002):** Méthodologie de l'extraction des hydrocarbures polycycliques. Application à des sédiments de la lagune de Bizerte (Tunisie). *C. R. Géosciences*, 334, 893-901.
- Sfakianakis, D. G., G. Koumoundouros, P. Divanach & M. Kentouri (2004):** Osteological development of the vertebral column and of the fins in *Pagellus erythrinus* (L. 1758). Temperature effects on the development plasticity and morphoanatomical abnormalities. *Aquaculture*, 232, 407-424.
- Sloof, W. (1982):** Skeletal anomalies in fish from polluted surface waters. *Aquat. Toxicol.*, 2, 157-173.

Original scientific article  
Received: 2011-08-01

UDK 591.159:597.551.2(535)

## SCALE DEFORMITIES IN ROHU *LABEO ROHITA* (OSTEICHTHYES: CYPRINIDAE)

Laith A. JAWAD & Juma A. AL-MAMRY

Marine Science and Fisheries Centre, Ministry of Agriculture and Fisheries Wealth, PO Box 427, Post Code 100, Muscat, Sultanate of Oman  
E-mail: laith\_jawad@hotmail.com

### ABSTRACT

*The present study describes the feature of scale deformities and disorientations in Rohu, Labeo rohita originating from the Indian subcontinent and obtained from the frozen fish market in the Sultanate of Oman. Scales located at the caudal peduncle region of the fish body showed two types of abnormalities, slight and severe; within each type a number of cases were observed. Disoriented scales rotated dorsally or ventrally away from the normal scale position without any projection of the scales outwards from the body surface. Abnormal scales, both regenerated and ontogenetic, exhibit significantly larger focus diameter, higher number of radii and similar shape relative to normal scales. Several factors as causative agents of scale abnormality and disorientation were discussed and evaluated.*

**Keywords:** Scale deformity, *Labeo rohita*, Muscat, Oman

## DEFORMITÀ DELLE SCAGLIE DI ROHU, *LABEO ROHITA*, (OSTEICHTHYES: CYPRINIDAE)

### SINTESI

*Il presente studio descrive le caratteristiche di deformità e disorientamento delle scaglie di Rohu, Labeo rohita, originario dal subcontinente indiano ed ottenuto congelato dal mercato di pesce del Sultanato dell'Oman. Le scaglie poste nella regione del peduncolo caudale del corpo del pesce mostravano due tipi di anomalie, leggera e grave. Di ogni tipo sono stati osservati diversi casi. Le scaglie disorientate erano ruotate dorsalmente o ventralmente in confronto alla posizione normale, senza alcuna proiezione delle scaglie verso l'esterno dalla superficie corporea. Le scaglie anormali, sia rigenerate che ontogenetiche, esibivano diametri focali significativamente più grandi, un più alto numero di raggi e forme simili alle scaglie normali. Gli autori ipotizzano e valutano diversi fattori quali agenti causali di deformità e disorientamento delle scaglie.*

**Parole chiave:** Deformità delle scaglie, *Labeo rohita*, Muscat, Oman

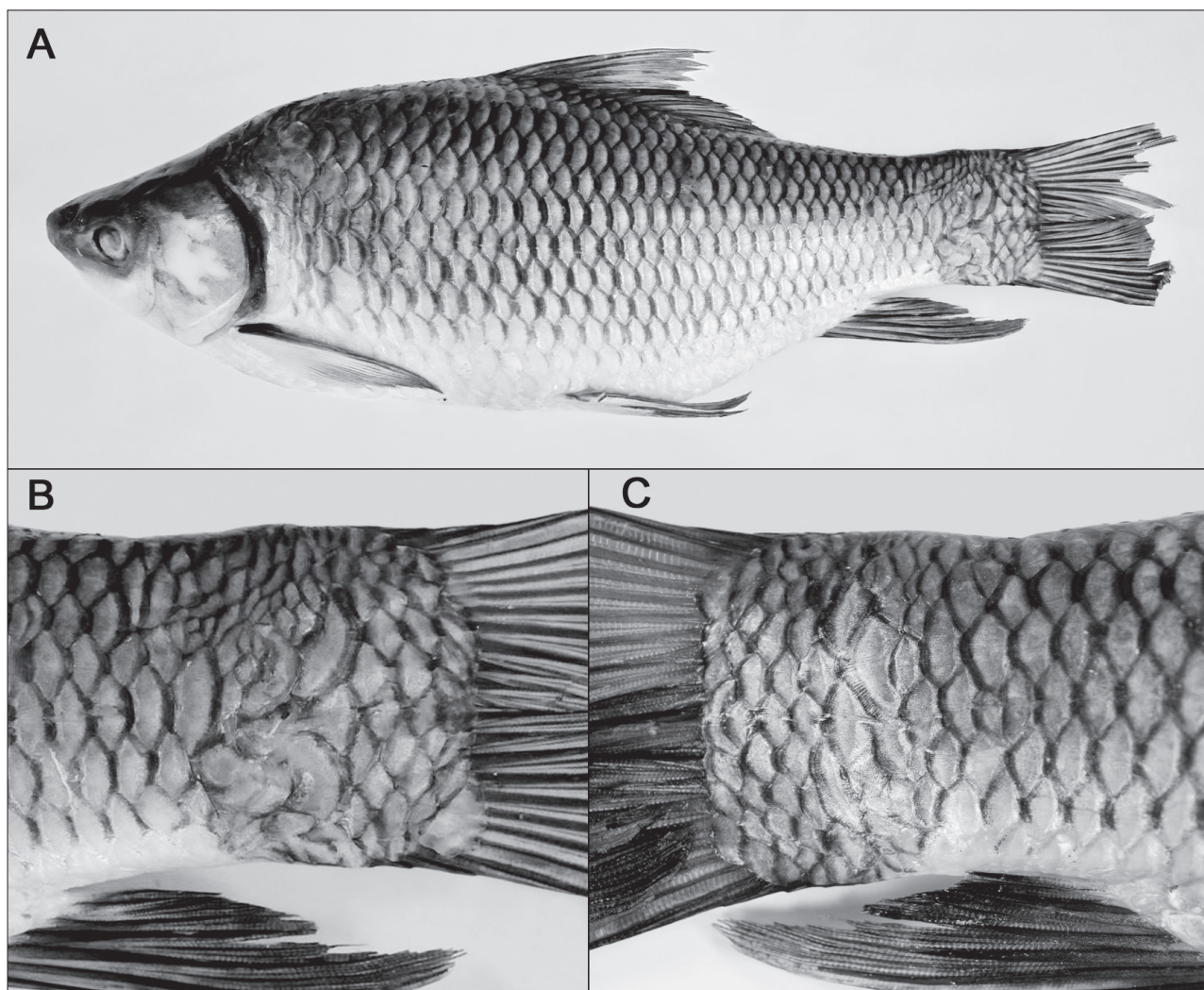
## INTRODUCTION

*Labeo rohita* (Hamilton) or Rohu is a cyprinid species, native inhabitant of rivers, streams, lakes and canals, of Bangladesh, India, Pakistan, Nepal and Myanmar.

Rohu is the most important among the three Indian major carp species used in carp polyculture systems. In India, it has been transplanted into almost all riverine systems including the freshwaters of Andaman, where we can now find a successfully established population (Ayyappan & Jena, 2001). In Oman, *L. rohita* is usually collected frozen from a supermarket where it is offered for sale. The anatomy and developmental patterns of fish scales and the relationship of scale morphology to genetic and environmental factors have already been reported (Blair, 1942; Yamanda, 1961; Fouda, 1979;

Sire, 1986; Bereiter-Han & Zylberberg, 1993). Scale deformities in wavy band sole, *Zebrias japonica* were reported by Taki (1938); in red drum, *Sciaenops ocellatus* by Gunter (1941, 1945, 1948), in coitor croaker "*Sciaena coitor*" (= *Johnius coitor*) by Mookerjee (1948), Corrales *et al.* (2000) reported on scale disorientation in pinfish, *Lagodon rhomboids*, Jawad (2005a) reported Siamese scales in Nile tilapia, *Oreochromis niloticus*; Jawad (2005b) described them in *Barbus arabicus*, *Barbus exolatus*, *Labeo niloticus* (Cyprinidae), and *Lates niloticus* (Centropomidae). Jawad (2005c) and Jawad (2007) found scale deformities in different species of the Tripterygiidae family, and Jawad & Al-Jufaili (2007) recorded them in *Saurida tumbil*.

The present article reports the first record of scale deformity in *L. rohita*.



**Fig. 1:** *Labeo rohita* specimen showing abnormal scales on the caudal peduncle area. A: general view; B: left side; C: right side.

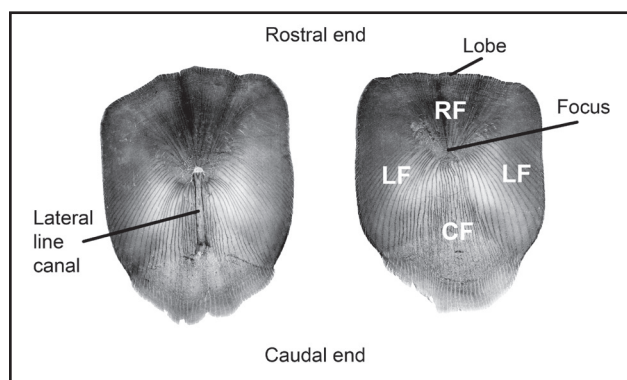
**Sl. 1:** *Primerek vrste Labeo rohita z nepravilnimi luskami v predelu med predrepno in repno plavutjo.* A: generalni pogled; B: leva stran; C: desna stran.

## MATERIAL AND METHODS

Ten specimens of *L. rohita* ranging from 356 to 375 mm standard length were collected in May 2010 from the frozen fish market in Muscat City, Sultanate of Oman. The origin of the specimens was traced back to several localities in India. All of the specimens showed to bear deformed scales on their caudal peduncle area (Figs. 1a-c). The angle of growth of each scale was recorded relative to the normal scales in adjacent areas outside of the abnormal patch. Degrees of deviation from normal were used to set the direction of the abnormal scales. Such degrees were grouped into 30 degree increments (i.e.,  $0^\circ$  = reversed, free edge toward the head of the fish and  $180^\circ$  = normal, free edge toward the tail of the fish).

The surface area of each abnormal scale patch was expressed as the percentage of the body surface on a single side of a fish where scale abnormality is shown. Scale abnormality areas were measured on all rohu fish specimens, obtained from the frozen fish market which exhibited scale abnormality ( $n = 10$ ) (Corrales *et al.* (2000)). These areas were measured by tracing the outline of the fish (exclusive of the head and fins) and each abnormal scale patch onto a tracing paper, one side at a time. Areas of abnormal scale regions were estimated using graph paper.

Normal and abnormal scales (37 scales per fish) were cleaned in 1% KOH solution and stained with alizarine red S stain to reveal the scale surface ornamentation. Four variables were measured for each scale: anterior-posterior length (major axis), dorso-ventral length (minor axis), diameter of the focus in the centre of the scale, number of radial lines (radii) radiating from near focus, and the ratio of major to minor axes was calculated as a measure of scale shape.



**Fig. 2: Principal scale fields of *L. rohita*. Left: Lateral line scale. Right: RF - rostral field; LF - lateral field; CF - caudal field.**

**Sl. 2: Glavni deli lusk pri vrsti *L. rohita*. Levo: lateralna linija luske. Desno: R - rostralni predel; LF - lateralni predel; CF - kavdalni predel.**

## RESULTS

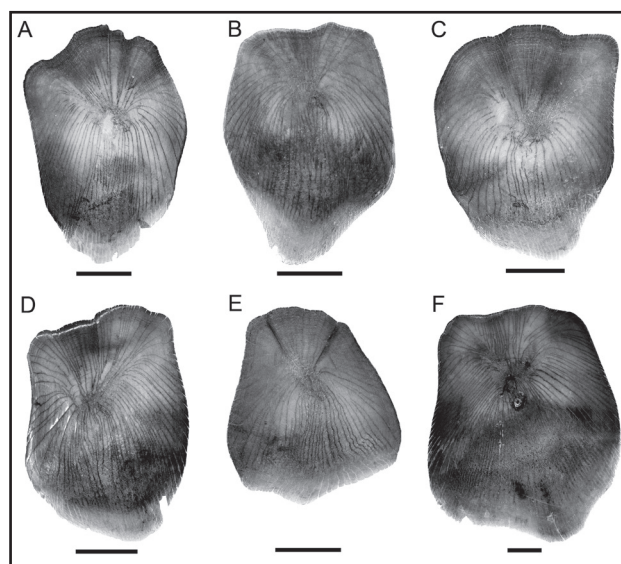
Four fields were recognized in the scale of *L. rohita*: rostral, two lateral and caudal. Scale dimensions, total scale width and anterior radius from the focus to the anterior edge of the scale were chosen to give a measure of scale size (Fig. 2).

## Description of scale deformities

In body scales, two categories of scale deformity were observed: slight and severe. In the first category, two cases were common and are shown in Figure 3. Other uncommon slight deformities were also recorded (Fig. 4). For lateral line scales four slight deformities were obtained and are shown in Figures 5a-d. As to the severe cases, there are five cases observed and recorded from patches of different fish specimens (Fig. 6). Three cases were observed in body scale (Figs. 6a-c) and two cases were observed in lateral line scale (Figs. 6d-e). Of the body scale, one scale with no focus area but an external fold containing only circuli instead lies on the rostral end of the scale. The second extreme example is a scale with an irregular shape and severely deformed sides. The third severely damaged scale is an elongated scale, narrow and short with no focus but a pocket structure with circuli instead covers the rostral end and runs on the sides.

Deformities include irregularities in scale shape, and irregularities and displacement of the lateral line canal and twin scales.

There are six shapes of scales in the deformed scale patch, namely triangular, elongated, squarish, truncate,



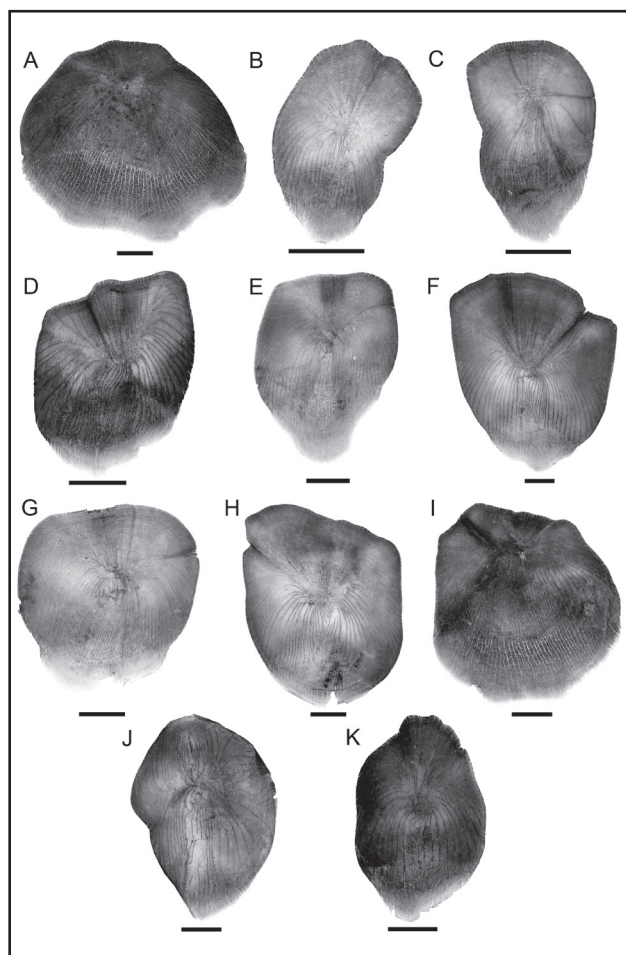
**Fig. 3: Common slight body scale deformities in *L. rohita*. Sl. 3: Običajne manjše deformacije lusk na telesu vrste *L. rohita*.**

pyriform and oblong. The most common shape for the body and lateral line scales was the pyriform shape (Fig. 7).

#### Orientation of scales in the abnormal scale patches

In each patch of the abnormal scales there were a number of disoriented scales. The disoriented scales felt rough to the touch compared to the neighbouring scales. The direction of growth of the disoriented scales deviated from 120°–220°, they were flat and never projecting up from the surface of the fish. Moreover, the patches of the abnormal scales were never observed to involve any ulceration or other overt damage to the epidermal layers.

The patches of scales were represented as a continuous patch over and under the lateral line. The size of the patches ranges between 4.3–8.1 % of the body surface.



**Fig. 4:** Uncommon slight body scale deformities in *L. rohita*.

**Sl. 4:** Neobičajne manjše deformacije lusk na telesu vrste *L. rohita*.

#### Scale morphology

Abnormal scales, both regenerated and ontogenetic, were significantly smaller in both major and minor axes than normal scales (t-test,  $p < 0.05$ ). The difference in the ratio of major to minor axes was not significant (t-test,  $p > 0.05$ ), making them similar in shape. The number of radii observed in abnormal scales, both regenerated and ontogenetic, was significantly higher than in normal scales (t-test,  $p < 0.05$ ; Tab. 1).

**Tab. 1:** Morphology of the normal and abnormal scales from *L. rohita* obtained from frozen fish market at Muscat, Oman. Scales from abnormal scale patches were subdivided based on focus diameter into ontogenetic or regenerated type. All values as mean values in mm (No. = 10 fish).

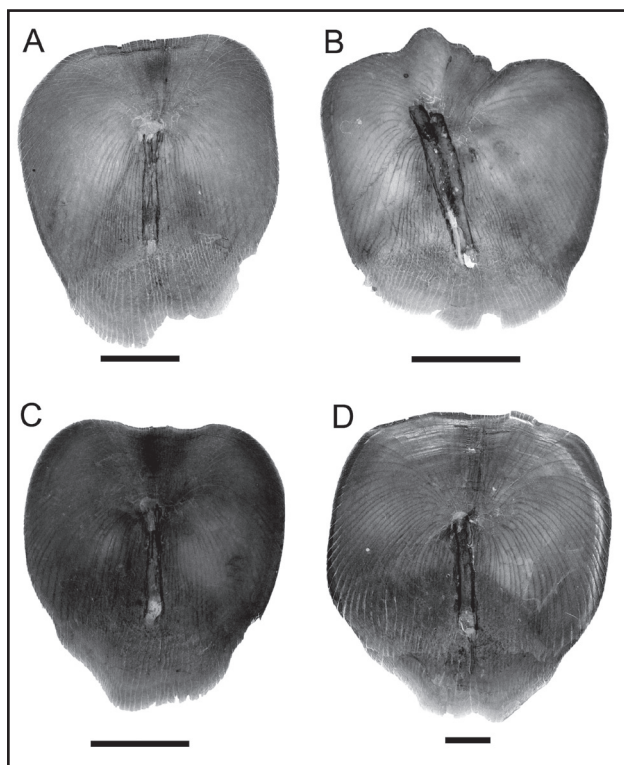
**Tab. 1:** Morfologija normalnih in abnormalnih lusk primerkov *L. rohita*, pridobljenih na tržnici z zmrznjenimi ribami v kraju Muscat, Oman. Abnormalne luske so razdeljene na ontogenetski in regeneriran tip, glede na premer fokusa. Podane vrednosti so povprečne vrednosti v mm (No. = 10 rib).

Scale measurements	Normal scales	Abnormal Scales	
		Regenerated scales	Ontogenetic scales
No. Scales	240	120	250
Focus diameter (mm)	2.5	3.5	3.1
Scale length (mm)	21.8	13.8	13.1
Scale width (mm)	16.6	11.1	10.7
Length/width ratio	1.3	1.2	1.2
Number of radii	6.8	9.2	9.1

Focus diameter was used as an index to classify scales into two types: ontogenetic and regenerated. The results showed that normal scales have smaller focus size than abnormal scales, both ontogenetic and regenerated.

#### DISCUSSION

The results obtained raise an important question of the nature of the etiologic factor or factors which trigger the development of abnormalities in scale morphology and disorientation. Corrales *et al.* (2000) suggested that there are four possible general groups of agents that were involved in the production of the scale anomalies in general: genetic, infectious, physical and chemical. Pathological studies on skin ulcerations in a variety of fish species have shown that these can be caused by injuries from fishing gear (Møllergaard & Bagge, 1998), bacterial and fungal infections (Noga *et al.*, 1988; Hilger *et al.*, 1991), a combination of infections and injury (Ludemann, 1993) and chemical agents (Minchew & Yarbrough, 1977; Fournie *et al.*, 1996).



**Fig. 5: Slight scale deformities of the lateral line scale of *L. rohita*.**

**Sl. 5: Manjše deformacije lusk lateralnega predela pri vrsti *L. rohita*.**

Genetic factors have been shown to result in several types of diseases and gross fish anomalies including a variety of vertebral deformities (Schultz, 1963; Tave *et al.*, 1982; Jawad & Öktener, 2006; Jawad & Hosie, 2007; Al-Mamry *et al.*, 2010; Jawad *et al.* 2010), albinism (Rothbard & Wohlfarth, 1993; Jawad *et al.*, 2007) and melanoma (Schartl *et al.*, 1982). At this point, it is impossible to comment on the genetic factor as an agent causing the scale deformity in *L. rohita* for two reasons: firstly, the specimens are an imported commodity in Oman, and secondly, as far as the authors are concerned, there are no studies available on the effect of the genetic factor in developing fish anomalies in India.

Infections with bacteria, protozoan, virus and fungus have been shown to produce necrosis, granuloma, hyperplasia and hypertrophy in the epidermis and dermis of fish (Noga, 1996). Abnormal growth of scales can occur if any of these phenomena takes action. Freshwater fish species in India and in particular *L. rohita* have been known to be exposed to bacterial infection (Lio-Po & Lim, 2000), but no records about the bacterial action in producing scale anomalies have been documented.

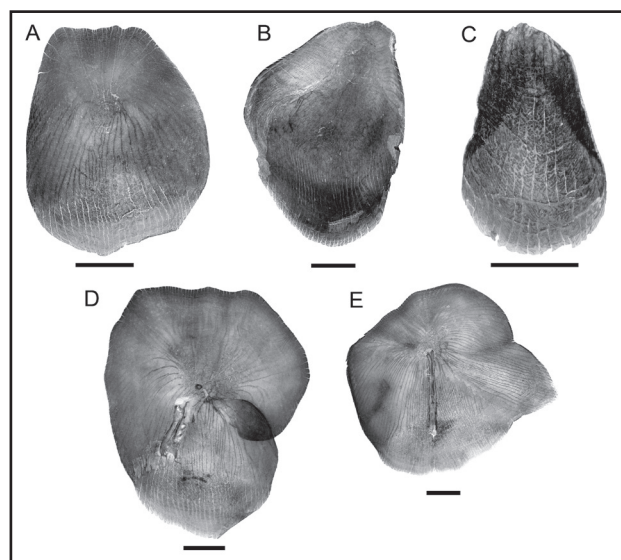
In several fish species, physical injuries obtained during the growth of the scales have shown not to play the main role in producing scale anomalies and disori-

entation, but are considered a co-factor in producing such changes (Corrales *et al.*, 2000).

The localization of the abnormal scale patches to the caudal peduncle suggests that either the scales in this area of the body are genetically more susceptible to development of abnormality or that this region is more likely to be exposed to the etiologic factor of anomalies. Rodger (1991) noted that UV exposure had been shown to cause skin damage in localised fish body surface in several fish species, creating a syndrome resembling 'sun burn' in mammals. However, according to the mentioned authors, no data on the effect of UV light exposure in producing scale anomalies in fish is available from the Indian subcontinent.

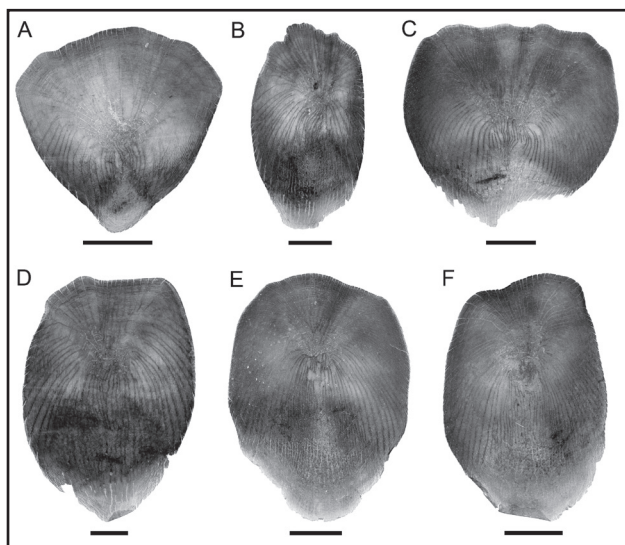
There are slight differences in salinity and temperature regimes of the regions where the fish specimens were originally collected. However, these differences are typically small in comparison with the seasonal fluctuations, occurring within any of the areas (Acharya *et al.*, 2005).

The last group of potential etiologic factors is the organic and inorganic chemicals found in the water column and sediments where *L. rohita* specimens used to live in their original environment. There is a possibility for the chemical agents to be collected via contact with the skin or gills and /or by ingestion. Among these chemical agents there is tributyltin substance that is used as biocides and enters in the content of most herbicides, causes hyperplasia of the dermal layers of the skin in Atlantic salmon, resulting in protruding scales (Bruno & Elis, 1988). The use of this chemical as herbi-



**Fig. 6: Severe body and lateral line scale deformities of *L. rohita*.**

**Sl. 6: Večje deformacije lusk na telesu in lateralnem predelu pri vrsti *L. rohita*.**



**Fig. 7: Shape of scales of *L. rohita*.**  
**Sl. 7: Oblika lusk pri vrsti *L. rohita*.**

cide component was reported to have effect on *L. rohita* (Sijatha *et al.*, 1996; Das & Mukherjee, 2000; Saravanan & Sundaramoorthy, 2010). Heavy metals and organic pollution of water and sediments seem to be the main reason behind the vertebral anomalies in fishes (Bengtsson, 1974; Benoit & Holcombe, 1978; Bengtsson *et al.*,

1988; Middaugh *et al.*, 1990). Fournie *et al.* (1996) reported that skin lesions (mainly fin erosion, ulcerations and papillomas) were more evident in areas with chemically contaminated sediments. Moreover, it has been found that demersal fish are more likely to be affected than pelagic fish. In the case of *L. rohita*, heavy metals were reported to be present in its original environment (Rauf *et al.*, 2009; Zutshi *et al.*, 2010) in addition to the fact that it is a fish species with demersal feeding habits (FAO, 2010).

Since the present observations were not conducted in the area where the fish specimens had been obtained, it is not possible at this stage to determine the correlations between severity of scale abnormalities and locations of potentially toxic sediments. The generally higher contaminant levels reported to be present in the original environment of the species in question correspond to the trend which would be predicted if chemical agents were an important component in the development of the scale abnormality. However, a direct proof of such an etiology, including identification of the specific agents responsible, would require experimental exposure of *L. rohita* to a variety of contaminants and/or sediment types found in the original area of the species studied. This is a call for the environmentalists in the Indian subcontinent to conduct further research on this important issue in the future to unveil the relationship between pollutants and the scale deformity discussed in the present work.

## DEFORMACIJE LUSK PRI VRSTI *LABEO ROHITA* (OSTEICHTHYES: CYPRINIDAE)

Laith A. JAWAD & Juma A. AL-MAMRY

Marine Science and Fisheries Centre, Ministry of Agriculture and Fisheries Wealth, PO Box 427, Post Code 100, Muscat, Sultanate of Oman  
 E-mail: laith\_jawad@hotmail.com

### POVZETEK

Pričujoča študija opisuje deformacije in dezorientacijo lusk pri vrsti rohu, *Labeo rohita*, ki izvira z Indijske podceline. Obravnavani primerki so bili pridobljeni na tržnici z zmrznjenimi ribami v Sultanatu Oman. Na luskah v predelu med predrepno in repno plavutjo sta bili opaženi dve vrsti nepravilnosti, manjše in večje; zabeleženo je bilo več primerov obeh vrst nepravilnosti. Dezorientirane luske, zasukane dorzalno ali ventralno od normalne pozicije lusk, ne štrlijo stran od površine telesa. Abnormalne luske, tako regenerirane kot ontogenetske, imajo opazno večji premer fokusa, večje število radijev in normalnim luskam podobno obliko. V članku so obravnavani in ocenjeni tudi različni faktorji, ki bi lahko delovali kot povzročitelji nepravilnosti in dezorientacije lusk.

**Ključne besede:** deformacija lusk, *Labeo rohita*, Muscat, Oman

## REFERENCES

- Acharya, S., T. Dutta & M. Das (2005):** Physiological and ultrastructural changes in *Labeo rohita* (Hamilton-Buchanan) fingerlings exposed to sublethal acidic and alkaline pH for long duration. *Asian Fish. Sci.*, 18, 295-305.
- Al-Mamry, J. M., L. A. Jawad, I. H. Al-Rasady & S. H. Al-Habsi (2010):** First record of dorsal and anal fin deformities in silver pomfrets, *Pampus argenteus* (Stromateidae, Actinopterygii). *Ann. Biol.*, 32, 73-77.
- Ayyappan, S. & J. N. Jena (2001):** Sustainable freshwater aquaculture in India. In: Pandian, T. J. (ed.): Sustainable Indian Fisheries. National Academy of Agricultural Sciences, New Delhi, India, pp. 83-133.
- Bengtsson, A., B. E. Bengtsson & G. Lithner (1988):** Vertebral defects in fourhorn sculpin, *Myoxocephalus quadricornis* L., exposed to heavy metal pollution in the Gulf of Bothnia. *J. Fish Biol.*, 33, 517-529.
- Bengtsson, B. E. (1974):** Vertebral damage to minnows *Phoxinus phoxinus* exposed to zinc. *Oikos*, 25, 134-139.
- Benoit, D.A. & G. W. Holcombe (1978):** Toxic effects of zinc on fathead minnows *Pimephales promelas* in soft water. *J. Fish Biol.*, 13, 701-708.
- Bereiter-Hahn, J. & L. Zylberberg (1993):** Regeneration of teleost fish scale. *Comp. Biochem. Physiol. A*, 105, 625-641.
- Blair, A. A. (1942):** Regeneration of the scales of Atlantic salmon. *J. Fish. Res. Board Can.*, 5, 440-447.
- Bruno, D. W. & A. E. Ellis (1988):** Histopathological effects in Atlantic salmon, *Salmo salar* L., attributed to the use of tributyltin antifoulant. *Aquaculture*, 72, 15-20.
- Corrales, J., L. B. Nye, S. Baribeau, N. J. Gassman & M. C. Scmale (2000):** Characterization of scale abnormalities in pinfish, *Lagodon rhomboids*, from Biscayne Bay, Florida. *Environ. Biol. Fish.*, 57, 205-220.
- Das, B. K. & S. C. Mukherjee (2000):** A histopathological study of carp (*Labeo rohita*) exposed to hexachlorocyclohexane. *Veterinarski Arch.*, 70, 169-180.
- FAO (2010):** Cultured aquatic species information programme, *Labeo rohita* (Hamilton, 1822). FAO Fisheries & Aquaculture *Labeo rohita*.mht downloaded on 18 November 2010.
- Fouda, M. M. (1979):** Studies on scale structure in the common goby *Pomatoschistus microps* Kroyer. *J. Fish Biol.*, 15, 173-183.
- Fournie, J. W., J. K. Summers & S. B. Weisberg (1996):** Prevalence of gross pathological abnormalities in estuarine fishes. *Trans. Am. Fish. Soc.*, 125, 581-590.
- Gunter, G. (1941):** A rare abnormality, a fish with reversed scales. *Copeia*, 1941(3), 176.
- Gunter, G. (1945):** Another redfish, *Sciaenops ocellatus* (Linnaeus), with reversed scales. *Ichthyol. Notes*, 1, 55.
- Gunter, G. (1948):** A discussion of abnormal scale patterns in fishes, with notice of another specimen with reversed scales. *Copeia*, 1948, 280-285.
- Hilger, I., S. Ullrich & K. Anders (1991):** A new ulcerative flexibacteriosis-like disease ('yellow pest') affecting young atlantic cod *Gadus morhua* from the German Wadden Sea. *Dis. Aquat. Org.*, 11, 19-29.
- Jawad, L. A. (2005a):** Comparative scale morphology and squamation patterns in triplefins (Pisces: Teleostei: Perciformes: Tripterygiidae). *Tuhinga*, 16, 137-167.
- Jawad, L. A. (2005b):** Comparative morphology of scales of four teleost Fishes from Sudan and Yemen. *J. Nat. Hist.*, 39, 2643-2660.
- Jawad, L. A. (2005c):** Scale deformities in Nile tilapia, *Oreochromis niloticus* (Actinopterygii: Cichlidae) from Sudan. *Acta Ichthyol. Piscat.*, 35, 61-63.
- Jawad, L. A. (2007):** Comparative morphology of the otolith of the Triplefins (Family: Tripterygiidae). *J. Nat. Hist.*, 41, 901-924.
- Jawad, L. A. & A. A. Öktener (2006):** Incidence of lordosis in the freshwater mullet, *Liza abu* (Heckel, 1843) collected from Atatürk Dam Lake, Turkey. *Ann. Biol.*, 28, 105-110.
- Jawad, L. A. & S. Al-Jufaili (2007):** Scale morphology of greater lizardfish, *Saurida tumbi* (Bloch, 1795) (Pisces: Synodontidae). *J. Fish Biol.*, 70, 1185-1212.
- Jawad, L. A. & A. Hosie (2007):** On the record of pug-headedness in snapper, *Pagrus auratus* (Forster, 1801) (Perciformes, Sparidae) from New Zealand. *Acta Adriat.*, 48, 205-210.
- Jawad, L. A., S. T. Ah Yong & A. Hosie (2007):** Malformation of the lateral line and ambicolouration in the triplefin *Grahamina capito* (Jenyns, 1842) (Pisces: Tripterygiidae) from New Zealand. *Ann. Mus. Civ. Stor. Nat. Ferrara*, 9/10, 89-97.
- Jawad, L. A., Z. Sadighzadeh & T. Valinassab (2010):** Malformation of the caudal fin in the freshwater mullet, *Liza abu* (Actinopterygii: Mugilidae) collected from Karkhe River, Iran. *Ann. Biol.*, 32, 11-14.
- Lio-Po, G. D. & L. H. S. Lim (2000):** Infectious diseases of warmwater fish in freshwater. In: Woo, P. T. K., D. W. Bruno & L. H. S. Lim (eds.): Diseases and disorders of finfish in cage culture. CAP Intern., pp. 231-249.
- Ludemann, K. (1993):** Fishery-induced skin injuries in flatfish from the by-catch of shrimpers. *Dis. Aquat. Org.*, 16, 127-132.
- Møllergaard, S. & O. Bagge (1998):** Fishing gear-induced skin ulceration in Baltic cod, *Gadus morhua* L. *J. Fish Dis.*, 21, 205-213.
- Middaugh, D. P., J. W. Fournie & M. J. Hemmer (1990):** Vertebral abnormalities in juvenile inland silversides *Menidia beryllina* exposed to terbufos during embryogenesis. *Dis. Aquat. Org.*, 9, 109-116.
- Minchew, C. D. & J. D. Yarbrough (1977):** The occurrence of fin rot in mullet (*Mugil cephalus*) associated with crude oil contamination of an estuarine pond-ecosystem. *J. Fish Biol.*, 10, 319-323.
- Mookerjee, S. (1948):** An atypical scale of *Sciaenops coitor* (Hamilton). *Nature*, 161(4080), 64-65.

- Noga, E. J. (1996):** Fish disease: diagnosis and treatment. Mosby-Year Book, St. Louis, 367 p.
- Noga, E. J., J. F. Levine, M. J. Dykstra & J. H. Hawkins (1988):** Pathology of ulcerative mycosis in Atlantic menhaden *Brevoortia tyrannus*. Dis. Aquat. Org., 4, 189–197.
- Rauf, A., M. Javed & M. Ubaidullah (2009):** Heavy metal levels in three major carps (*Catla catla*, *Labeo rohita* and *Cirrhina mrigala*) from the River Ravi, Pakistan. Pak. Vet., 29, 24–26.
- Roger, H. D. (1991):** Summer lesion syndrome in salmon: a retrospective study. Vet. Rec., 129, 237–239.
- Rothbarf, S. & G. W. Wohlfarth (1993):** Inheritance of albinism in the grass carp, *Ctenopharyngodon idella*. Aquaculture, 115, 13–17.
- Saravanan, P. R. & M. Sundaramoorthy (2010):** Studies on effects of chronic exposure of endosulfan to *Labeo rohita*. J. Environ. Biol., 31, 755–758.
- Schartl, M., A. Barnekow & H. Bauer (1982):** Correlations of inheritance and expression between a tumor gene and the cellular homolog of the Rous sarcoma virus-transforming gene in *Xiphophorus*. Cancer Res., 42, 4222–4227.
- Schultz, R. J. (1963):** Stubby, a hereditary vertebral deformity in the viviparous fish *Poeciliopsis prolifica*. Copeia, 1963, 325–330.
- Sijatha, C. H., S. M. Nair & J. Chacko (1996):** Tributyltin oxide induced physiological and biochemical changes in a tropical estuarine clam. Bull. Environ. Contam. Toxicol., 56, 303–310.
- Sire, J. Y. (1986):** Ontogenic development of surface ornamentation in the scales of *Hemichromis bimaculatus* (Cichlidae). J. Fish Biol., 28, 713–724.
- Taki, I. (1938):** On the abnormal arrangement of scales and colour bands in a sole (*Zebrias*), with special reference to its adverse scales. J. Sci. Hiroshima Univ. B 1, 6, 1–14.
- Tave, D., J. E. Bartels & R. O. Smitherman (1982):** Stumpbody *Sarotherodon aureus* (Steindachner) (= *Tilapia aurea*) and tail-less *S. niloticus* (L.) (= *T. nilotica*): two vertebral anomalies and their effects on body length. J. Fish Dis., 5, 487–494.
- Yamada, J. (1961):** Studies on the structure and growth of the scales in the goldfish. Mem. Fac. Fish. Hokkaido Univ., 9, 181–226.
- Zutshi, B., S. G. Raghu Prasad & R. Nagaraja (2010):** Alteration in hematology of *Labeo rohita* under stress of pollution from Lakes of Bangalore, Karnataka, India. Environ. Monit. Assess., 168, 11–19.

Original scientific article  
Received: 2011-09-15

UDK 597.556.255:591.9(262.26)

## NEW RECORDS OF THE LESSEPSIAN MIGRANT, BLUESPOTTED CORNETFISH, *FISTULARIA COMMERSONII* (OSTEICHTHYES: FISTULARIDAE) OFF THE TUNISIAN COAST (CENTRAL MEDITERRANEAN)

*Sihem RAFRAFI-NOUIRA, Néjia MNASRI & Moncef BOUMAÏZA*

Laboratoire d'Hydrobiologie Littorale et Limnique, Université du 07 novembre à Carthage, Faculté des Sciences, Zarzouna, 7021 Bizerte, Tunisia

*Christian REYNAUD & Christian CAPAPÉ*

Laboratoire interdisciplinaire de Recherche sur la Didactique, l'Éducation et la Formation, E. A. 3749, case 77, Université Montpellier II, Sciences et Techniques du Languedoc, 34095 Montpellier cedex 5, France  
E-mail: capape@univ-montp2.fr

### ABSTRACT

*Fourteen specimens of the bluespotted cornetfish *Fistularia commersonii* were recorded in Tunisian marine waters suggesting that the species should be at present considered as successfully established in the area. All specimens were caught off Ras Jebel, these captures constituting the northernmost extension range of the species off the Tunisian coast. *F. commersonii* is a highly carnivorous species and its negative role in the biological environment cannot be neglected.*

**Key words:** morphology, morphometric measurements, meristic counts, water warming

## NUOVE SEGNALAZIONI DI PESCE FLAUTO, *FISTULARIA COMMERSONII* (OSTEICHTHYES: FISTULARIDAE), MIGRANTE LESSEPSIANO, AL LARGO DELLA COSTA DELLA TUNISIA (MEDITERRANEO CENTRALE)

### SINTESI

*Quattordici individui di Pesce Flauto, *Fistularia commersonii*, sono stati avvistati nelle acque marine della Tunisia, il che fa ipotizzare che la specie si sia stabilita con successo nell'area. Tutti gli esemplari sono stati catturati al largo di Ras Jebel. Tali catture rappresentano il punto più settentrionale di estensione della specie al largo della costa tunisina. *F. commersonii* è una specie altamente carnivora ed il suo ruolo negativo nell'ambiente biologico non può venir trascurato.*

**Parole chiave:** morfologia, misurazioni morfometriche, conteggi meristici, riscaldamento del mare

## INTRODUCTION

The bluespotted cornetfish *Fistularia commersonii* (Rüppel 1835) is a reef-associated species widely distributed in the Indo-Pacific, first recorded in the Mediterranean by Golani (2000). This new Lessepsian migrant (*sensu* Por, 1978) quickly expanded in the eastern Mediterranean (Golani *et al.*, 2002), and was classified by Karachle *et al.* (2004) as a "Lessepsian sprinter". *F. commersonii* was first recorded in the central Mediterranean by Azzurro *et al.* (2004) off Lampedusa Island, located 167 km from the eastern Tunisian coast, where it was further recorded by Ben Souissi *et al.* (2004) and Charfi-Cheikhronha (2004). The species migrated westward and was reported in relative abundance off the Algerian coast, between Tunisian and Moroccan borders (Hemida & Capapé, 2009). Additionally, *F. commersonii* was also reported in Libyan marine waters by Shakman & Kinzelbach (2007) and Elbaraasi & Elsalini (2009)

who noted that the establishment of the species in the area still remains difficult to determine. Recent observations reported by Deidun & Germanà (2011) showed increasing numbers of records of *F. commersonii* in the central Mediterranean, especially within the coastal waters of Sicily and off the Maltese Islands.

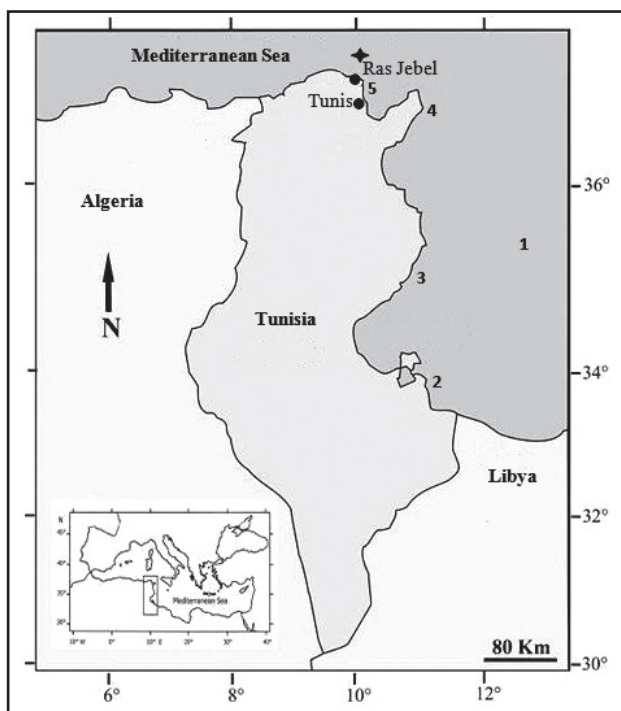
Additionally, *F. commersonii* constitutes a threat for native ecosystem because it is both an active feeder and a highly carnivorous species which considerably increases competition pressure with autochthonous species, mainly teleosts (Kalogirou *et al.*, 2007). Such pattern could have a double negative impact, firstly ecological and secondly economic; fistularid species having low selling prices as observed in western African fishmarkets (Diatta *et al.*, 2009; Y. Diatta, *pers. comm.*).

The aim of this note is to present new additional records of bluespotted cornetfish during investigations conducted in northeastern Tunisian marine waters since June 2006 and to comment on the distribution extension of this Lessepsian migrant off the Tunisian coast and in the Mediterranean.

## MATERIAL AND METHODS

All observed specimens were collected between 30 October 2010 and 24 September 2011, off Ras Jebel (37°19'32.04" N, 10°13'35.18" E), a city located approximately 60 km north of Tunis, by commercial gill-nets with 30 mm mesh size, at a depth of 8m. The habitat was a rocky bottom covered by algae, concomitantly with sparid and labrid species (Fig. 1).

All fresh specimens were identified following Golani (2000), Golani *et al.* (2002) and Hemida & Capapé (2009), and photographed. Morphometric measurements were recorded to the nearest millimetre, while total mass, masses of liver and gonads to the nearest decigram. The genital tract of each specimen was first examined under binocular microscope. The stomach contents were removed, sorted and weighed to the nearest decigram. The items were identified to the lowest



**Fig. 1:** Map of Tunisia showing the capture sites of *Fistularia commersonii* in the region. Black star: off Ras Jebel (this study); 1 - off Lampedusa Island (see Azzurro *et al.*, 2004); 2 - off Zarzis; 3 - off Sfax; 4 - off Kelibia (see Ben Souissi *et al.*, 2004); 5 - off Raf-Raf (see Charfi-Cheikhronha, 2004).

**Sl. 1:** Zemljevid Tunizije s označenimi točkami ulova primerkov *Fistularia commersonii*. Črna zvezda: pri mestu Ras Jebel (to delo); 1 - ob otoku Lampeduza (glej Azzurro *et al.*, 2004); 2 - pri mestu Zarzis; 3 - pri mestu Sfax; 4 - pri mestu Kelibia (glej Ben Souissi *et al.*, 2004); 5 - pri mestu Raf-Raf (glej Charfi-Cheikhronha, 2004).



**Fig. 2:** *F. commersonii* (ref. FSB-Fis-com 01) captured in Tunisian marine waters (scale bar 50 mm).

**Sl. 2:** *F. commersonii* (ref. FSB-Fis-com 01), ujeta v tunizijskih vodah (merilo 50 mm).

possible taxon using keys and fields (Riedl, 1963; Perrier, 1964, 1975; Fischer *et al.*, 1987).

All specimens were preserved in 10% buffered formalin and deposited in the Ichthyological Collection of the Faculté des Sciences of Bizerte (Tunisia), receiving catalogue numbers from FSB-Fis-com 01 (Fig. 2) to FSB-Fis-com 14.

## RESULTS AND DISCUSSION

The identification of the collected *Fistularia commersonii* was made as follows: skin entirely smooth with lack of both bony plates along midline of back and of spines in ossifications of the posterior lateral line, and on the occurrence of strongly serrate ridges on both edges of snout; body extremely depressed with a narrow tubular snout; dorsal and anal fins similar and triangular, posterior in position, opposite each other; caudal fin forked, with two very elongated and filamented middle rays. Colour brownish to olive-green with blue spots on the back. Belly beige, fins rather translucent and transparent

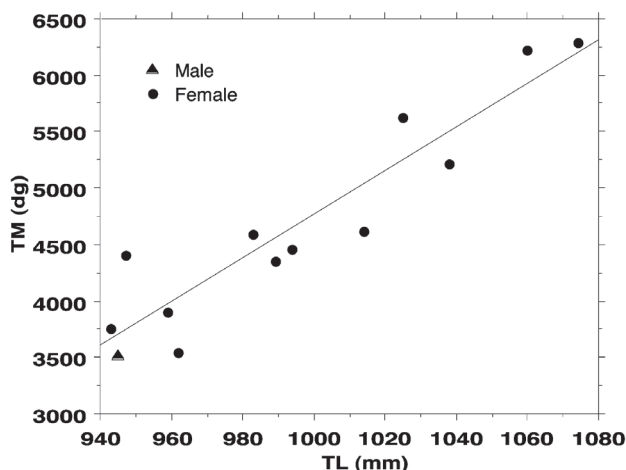
at base, with orange cast. Morphometric measurements, meristic counts of two specimens are given in Table 1. They agree with the description and colour provided by Golani (2000), Golani *et al.* (2002) and Hemida & Capapé (2009).

Of the 14 collected specimens, 12 were females and 2 males. All were large specimens ranging in size between 943 and 1074 mm total length, and weighing between 3516 and 6284 dg total mass. Of the 14 guts examined, 7 were empty, the other 7 contained remains of bony fishes. Namely, in four of them, we have identified bogue *Boops boops* (Linnaeus 1758), black goby *Gobius niger* (Linnaeus, 1758) and an unidentified sparid species (Tab. 2). These observations show that *F. commersonii* is a higher order carnivore, a piscivorous species in agreement with Kalogirou *et al.* (2007). All females exhibited a single ovary occupying the internal cavity of the body in its length and constituted in two fused lobes divided by a longitudinal septum of connective tissue in agreement with Azzuro *et al.* (2004); the ovary contained pre-vitellogenic oocytes. These females

**Tab. 1: Morphometric measurements, in mm and percent of standard length (% SL), meristic counts and masses recorded in both specimens of *Fistularia commersonii* (ref. FSB-Fis-com 01 and FSB-Fis-com 02) captured in Tunisian marine waters.**

**Tab. 1: Morfometrični podatki, v mm in odstotkih standardne dolžine (% SL), meristični podatki in mase, izmerjeno za oba primerka *Fistularia commersonii* (ref. FSB-Fis-com 01 in FSB-Fis-com 02), ujeta v tunizijskih vodah.**

Reference	FSB-Fis-com 01		FSB-Fis-com 02	
Morphometric measurements	mm	% SL	mm	% SL
Total length without filaments	847	104.8	811	103.7
Total length including filaments	989	122.4	943	120.5
Standard length	808	100.0	782	100.0
Pre-dorsal fin length	673	83.3	650	83.1
Pre-pectoral fin length	302	37.3	284	36.3
Pre-anal fin length	673	83.3	647	82.7
Snout length	221	27.3	208	26.5
Longitudinal ocular diameter	23	2.8	21	2.6
Vertical ocular diameter	10	1.2	8	1.05
Dorsal fin length	26	3.5	27	
Pectoral fin length	17	2.1	16	2.0
Anal fin length	29	3.6	26	3.3
Body height	25	3.0	22	2.8
<b>Meristic counts</b>				
Dorsal soft fin rays	15		15	
Pectoral soft fin rays	14		14	
Anal soft fin rays	14		15	
Caudal soft fin rays	16		16	
<b>Masses (g)</b>				
Total body	435.0		375.1	
Eviscerated body	372.6		341.7	
Liver	10.3		8.4	
Ovary	4.2		2.4	
Stomach content	9.4		6.3	



**Fig. 3: Relationship between total length (TL) and total mass (TM) in *F. commersonii* captured off Ras Jebel (northern Tunisia).**

**Sl. 3: Razmerje med celotno dolžino (TL) in celotno maso (TM) primerkov *F. commersonii*, ujetih pri kraju Ras Jebel (severna Tunizija).**

were probably pre-spawning specimens. Both males observed were immature specimens.

The relationship total length (TL) vs. total mass (TM) is plotted (Fig. 3):

$TM\ (dg) = -14506.344 + 19.273 \cdot TL\ (mm)$ ,  $n = 14$ ,  $r = 0.93$ ; it suggests that the species found sufficient food in the wild to develop.

The first record of *F. commersonii* in the central Mediterranean occurred on 20 December 2002 off Lampedusa Island (Azzurro et al., 2004), the other specimens from the close Tunisian coast were collected on November 2002 off Zarzis, on October 2003 off Sfax and Kelibia, respectively (Ben Souissi et al., 2004) and on January 2004 off Raf-Raf (Charfi-Cheikhronha, 2004). The species migrated westward and was recorded off the Algerian coast (Hemida & Capapé, 2009), and reached at present the Moroccan border (F. Hemida, pers. comm.). Deidun & Germanà (2011) noted the abundance in the Malta-Sicily shelf area, adding that sighted specimens were from 300 to 1100 mm in total length, with some being sold at the Marsaxlokk fish market, which is considered a novelty for the Maltese Islands. These reports in related areas suggest that a subsequent *F. commersonii* population is at present successfully established in the southern and central Mediterranean. Similar patterns were observed for three other teleost species in Tunisian waters, two lessepsian migrants Por's goatfish *Upeneus pori* Ben-Tuvia & Golani 1989 (Ben Souissi et al., 2005; Azzouz et al., 2010) and reticulated leatherjack *Stephanolepis diaspros* Fraser-Brünner 1940 (Ben Amor & Capapé, 2008).

The occurrence of new exotic species in Tunisian waters and other Mediterranean regions is due to the warming of Mediterranean waters, which makes this sea a catchment area for species from southern marine world regions (Ben Raïs Lasram & Mouillot, 2009). *F. commersonii* could be considered as one of the best instances among teleost species because since its first re-

**Tab. 2: Observations recorded in the 13 *F. commersonii* captured off Ras Jebel (northern Tunisia) with total length (TL), total mass (TM), liver mass (LM) and gonad mass (GM).**

**Tab. 2: Podatki za 13 primerkov *F. commersonii*, ujetih pri kraju Ras Jebel (severna Tunizija) s celotno dolžino (TL), celotno maso (TM), maso jeter (LM) in maso gonad (GM).**

Record	Capture date	Sex	Condition	TL(mm)	TM (dg)	LM (dg)	GM (dg)	Stomach contents
01	30/10/2010	female	pre-spawning	989	4350	103	42	undeternined teleosts
02	28/11/2010	female	pre-spawning	943	3751	84	24	undeternined teleosts
03	03/12/2010	female	pre-spawning	1074	6284	115	70	empty
04	03/12/2010	female	pre-spawning	994	4461	95	26	empty
05	06/12/2010	female	pre-spawning	947	4400	106	68	<i>Boops boops</i> (6 dg), undetermined sparid
06	23/12/2010	female	pre-spawning	1025	5623	91	47	<i>B. boops</i> (45 dg)
07	29/12/2010	male	immature	945	3516	37	23	empty
08	09/01/2011	female	pre-spawning	983	4586	73	35	<i>Gobius niger</i> (92 dg)
09	09/01/2011	female	pre-spawning	1038	5218	89	45	empty
10	09/01/2011	female	pre-spawning	962	3547	64	34	undeternined teleosts
11	30/01/2011	female	pre-spawning	1060	6215	78	63	empty
12	30/01/2011	female	pre-spawning	959	3907	64	31	empty
13	30/01/2011	female	pre-spawning	1014	4624	-	42	empty
14	24/09/2011	male	immature	960	4035	-	32	<i>B. boops</i> (11 dg)

cord (Golani, 2000), it is known throughout the Mediterranean Sea, and at present, it is abundantly captured in the eastern Mediterranean (Golani et al., 2002), the Aegean Sea (Kalogirou et al., 2007) and in southern regions such as Maghreb shore; however, it is still unknown off the northern coast of Spain and southern coast of France. *F. commersonii* is a highly carnivorous species that considerably increases competition pressure with autochthonous species, mainly teleosts, which have high economic value (Kalogirou et al., 2007). Additionally, *F. commersonii*, species of low economic value, feed on species of high economic value such as centranthids, mullids and sparids (Kalogirou et al., 2007).

Consequently, a relative abundance of *F. commersonii* in Tunisian marine waters and in the neighbouring areas could have a double negative impact, ecological and economic, both very negative for the local human population. Nevertheless, these nefaste consequences have not yet been demonstrated, even if they remain a suitable hypothesis.

#### ACKNOWLEDGEMENTS

The authors wish to thank two anonymous referees for their useful and helpful suggestions that allowed the improvement of the manuscript.

## NOVI PODATKI O POJAVLJANJU LESEPSKE SELIVKE, MODROPIKASTEGA TROBENTAČA *FISTULARIA COMMERSIONII* (OSTEICHTHYES: FISTULARIDAE) OB TUNIZIJSKI OBALI (OSREDNJE SREDOZEMLJE)

Sihem RAFRAFI-NOUIRA, Néjia MNASRI & Moncef BOUMAÏZA

Laboratoire d'Hydrobiologie Littorale et Limnique, Université du 07 novembre à Carthage, Faculté des Sciences, Zarzouna, 7021 Bizerte, Tunisia

Christian REYNAUD & Christian CAPAPÉ

Laboratoire interdisciplinaire de Recherche sur la Didactique, l'Éducation et la Formation, E. A. 3749, case 77, Université Montpellier II, Sciences et Techniques du Languedoc, 34095 Montpellier cedex 5, France  
E-mail: capape@univ-montp2.fr

#### POVZETEK

Na podlagi opazovanj štirinajstih primerkov vrste modropikasti trobentač *Fistularia commersonii* iz tunizijskih obmorskih voda lahko vrsto trenutno obravnavamo kot uspešno uveljavljeno na tem območju. Vsi primerki so bili ujeti pri mestu Ras Jebel, kar predstavlja najsevernejši del območja razširjenosti vrste ob tunizijski obali. *F. commersonii* je izrazito mesojeda vrsta in njene negativne vloge v biološkem okolju ne gre zanemariti.

**Ključne besede:** morfologija, morfometrični podatki, meristični podatki, segrevanje morja

#### REFERENCES

**Azzouz, K., S. Mansour, M. Boumaïza & C. Capapé (2010):** Occurrence of the Por's goatfish *Upeneus pori* (Osteichthyes: Mullidae) in the Lagoon of Bizerte (northern Tunisia, central Mediterranean). *Annales, Ser. Hist. Nat.*, 20(1), 29-32.

**Azzurro, E., P. Pizzicori & F. Andaloro (2004):** First record of *Fistularia commersonii* (Fistularidae) from the Central Mediterranean. *Cybium*, 28(1), 72-74.

**Ben Amor, M. M. & C. Capapé (2008):** Occurrence of a filefish closely related to *Stephanolepis diaspros* (Osteichthyes: Monacanthidae) off northern Tunisian coast (south-western Mediterranean). *Cah. Biol. Mar.*, 49(3), 323-328.

**Ben Raïs Lasram, F. & D. Mouillot (2009):** Increasing southern invasion enhances congruence between endemic and exotic Mediterranean fish fauna. *Biol. Invasions*, 11(3), 697-711.

**Ben Souissi, J., J. Zaouali, M. N. Bradai & J.-P. Quignard (2004):** Lessepsian migrant fishes off the coast of Tunisia. First record of *Fistularia commersonii* (Osteichthyes, Fistularidae) and *Parexocoetus mento* (Osteichthyes, Exocoetidae). *Vie Milieu*, 54, 247-248.

**Ben Souissi, J., H. Mejri, J. Zaouali, J. & C. Capapé (2005):** On the occurrence of the goatfish, *Upeneus pori* Ben-Tuvia and Golani, 1989 (Mullidae) in Southern Tunisia (Central Mediterranean). *Cybium*, 29(4), 410-412.

**Charfi-Cheikhronha, F. (2004):** Premières observations de quatre espèces de poissons allochtones à Rafraf (nordest de la Tunisie). Bull. Inst. Sci. Technol. Mer Salammbô, 31, 115-117.

**Deidun, A. & A. Germanà (2011):** On the increasing occurrence of the Bluespotted Cornetfish *Fistularia commersonii* (Rüppel, 1838) (Osteichthyes, Fistulariidae) in the Central Mediterranean. Biodiversity J., 2(1), 19-26.

**Diatta, Y., P. Ndiaye, S. Ndaw, C. Reynaud & C. Capapé (2009):** Senegal fishery worth more than peanuts. JMBA-GME, 10, 12-13.

**Elbaraasi, H. & O. Elsalini (2009):** A record of bluespotted cornetfish, *Fistularia commersonii* (Axtinopterygii: Syngnathiformes: Fistulariidae), off the coast of Benghazi, Libya (southern Mediterranean). Acta Ichthyol. Piscat., 39(1), 63-66.

**Fischer, W., M. L. Bauchot & M. Schneider (1987):** Fiches FAO d'identification des espèces pour les besoins de la pêche (Révision.1). Méditerranée et Mer Noire. Zone de pêche 37. Vol. I & II. FAO, Rome, 1530 p.

**Golani, D. (2000):** First record of the bluespotted cornetfish from the Mediterranean Sea. J. Fish Biol., 56, 1545-1547.

**Golani, D., L. Orsi-Relini, E. Massuti & J.-P. Qui-gnard (2002):** CIESM Atlas of exotic species in the Mediterranean. Vol. 1. Fishes. (F. Briand ed.). CIESM Publications, Monaco, 256 p.

**Hemida, F. & C. Capapé (2009):** On the occurrence of a Lessepsian migrant teleost off the Algerian coast (southwestern Mediterranean): the bluespotted cornetfish, *Fistularia commersonii* (Osteichthyes: Fistularidae). Cybium, 33(1), 81-82.

**Kalogirou, S., M. Corsini, G. Kondilatos & H. Wennhage (2007):** Diet of the invasive piscivorous fish *Fistularia commersonii* in a recently colonized area of the eastern Mediterranean. Biol. Invasions, 9(8), 887-896.

**Karachle, P. K., C. Triantapylidis & K. I. Stergiou (2004):** Bluespotted cornetfish, *Fistularia commersonii* Rüppell, 1838: a Lessepsian sprinter. Acta Ichthyol. Piscat., 34(1), 103-108.

**Perrier, R. (1964):** La faune de la France illustrée. 1B. Vers et némathelminthes. Delagrave, Paris, 179 p.

**Perrier, R. (1975):** La faune de la France illustrée. II. Arachnides et crustacés. Delagrave, Paris, 220 p.

**Por, F. D. (1978):** Lessepsian migration. Ecological studies 23. Springer-Verlag, Berlin, New-York, 228 p.

**Riedl, R. (1963):** Fauna and flora der Adria. Paul Parey, Hamburg, 702 p.

**Shakman, E. & R. Kinzelbach (2007):** Distribution and characterization of Lessepsian migrant fishes along the coast of Libya. Acta Ichthyol. Piscat., 37(1), 7-15.

Saggio scientifico originale  
Ricevuto: 2011-10-10

UDK 581.9:574.1(450.657)

## PRODROMO DELLA FLORA DI LAMA DEI PELIGNI (REGIONE ABRUZZO E PARCO NAZIONALE DELLA MAJELLA)

Amelio PEZZETTA  
I 34149 Trieste, Via Monteperalba 34, Italia  
E-mail: fonterossi@libero.it

### SINTESI

*Il territorio del Comune di Lama dei Peligni occupa una superficie di circa 31 km<sup>2</sup> tra le altitudini minima di 286 m s.l.m e massima di 2690. È situato in Provincia di Chieti (Regione Abruzzo) ed è parzialmente compreso nel Parco Nazionale della Majella. Può essere distinto in un settore collinare con vari litotipi ed un settore montano dominato da rocce calcaree. Nel presente lavoro si riporta l'elenco floristico comprendente 937 entità ottenuto con ricerche sul campo e dati di letteratura. Di conseguenza su un territorio che rappresenta circa 0,01 % della superficie italiana attecchisce il 12 % della sua flora a dimostrazione dell'elevata biodiversità locale. I contingenti floristici più rappresentati sono il mediterraneo con 339 taxa, l'eurasiatico con 199 e l'europeo con 180 taxa. Inoltre le ricerche effettuate hanno portato a segnalare 207 nuovi taxa per l'area e 75 endemismi.*

**Parole chiave:** Lama dei Peligni, Flora, Majella, Abruzzo, fiume Aventino

## REGISTER OF THE FLORA OF LAMA DEI PELIGNI (REGION ABRUZZO AND NATIONAL PARK MAJELLA)

### ABSTRACT

*The territory of Lama dei Peligni covers 31 km<sup>2</sup> and lies between 286 m and 2690 m a.m.s.l. It is located in the province of Chieti, Abruzzo Region (Italy) and is a part of the National Majella Park. From a geological point of view, this territory can be classified as partly hilly with many different litotypes and partly mountainous with different types of calcareous rock. The author presents the inventory of native and naturalized vascular plant species growing within Lama dei Peligni. The checklist includes 937 taxa, which equates to about 12 % of the Italian flora, though the territory represents only 0.01 % of the country's surface area. The more widespread floristic contingents are: the Mediterranean with 339 taxa, the Eurasiatic with 199 taxa and the European with 180 taxa. The remarkable new taxa for the area are 207 and the endemic taxa are 75.*

**Keywords:** Lama dei Peligni, Flora, Majella, Aventino river

## INTRODUZIONE

Lama dei Peligni è un Comune abruzzese totalmente compreso nella Provincia di Chieti ed in parte anche nell'ambito del Parco Nazionale della Majella.

Il suo territorio si estende su una superficie di circa 31 km quadrati lungo l'asse SE-NO ed è posto tra le altitudini minima di 286 m e massima di 2690 m s. l. m. Può essere ripartito in un settore collinare percorso nella parte più bassa dal fiume Aventino ed uno montuoso detto "Vallone di Lama" posto al disopra di 750 m sul versante orientale della Majella, attualmente parte integrante dell'omonimo Parco Nazionale. Il settore collinare sino ai primi contrafforti calcarei magellensi presenta una pendenza media di circa il 12 %. Il settore montuoso invece dall'altitudine di 750 metri a circa 1500 metri è caratterizzato da una forte acclività. In seguito il pendio si addolcisce per assumere la forma di pianori altitudinali oltre la quota di 2400 metri.

La forma del territorio (Fig. 1) assomiglia ad un triangolo rettangolo con il cateto minore a sud del fiume Aventino ed il vertice ove si incontrano ipotenusa e cateto maggiore sul massiccio della Majella oltre Grotta Canosa. Nell'area in esame si possono osservare diverse

formazioni rocciose come risulta dalla Figura 2. Schematicamente si può far presente che il settore posto oltre 750 metri di altitudine è formato da vari tipi di rocce calcaree, mentre il settore collinare più basso da detriti di falda, argilla, marna, sabbia, arenaria, flysch, suoli a scheletro calcareo ed altro.

Per quanto riguarda il clima è innanzitutto da evidenziare che tutto il territorio gode di una favorevole esposizione a sud il che comporta un notevole soleggiamento e riscaldamento diurno.

L'ampia escursione altitudinale tuttavia non consente di definire per l'area in esame un'unica tipologia climatica. Infatti, secondo Frattaroli *et al.* (2006), lungo il gradiente altitudinale si osserva la successione climatica dal termotipo Mesotemperato superiore a quello Orotemperato inferiore con Ombrotipi che vanno dall'Umido inferiore all'Iperumido inferiore.

Il piano alpino al disopra di 2200 in tutti i periodi dell'anno è percorso da venti freddi ed impetuosi che superano frequentemente la velocità di 100 km/h. La copertura nevosa può iniziare talvolta già a fine settembre e si protrae comunemente da novembre a maggio-giugno. La temperatura media annua è di circa 2°C e le precipitazioni annue generalmente sono superiori a 1500 mm.

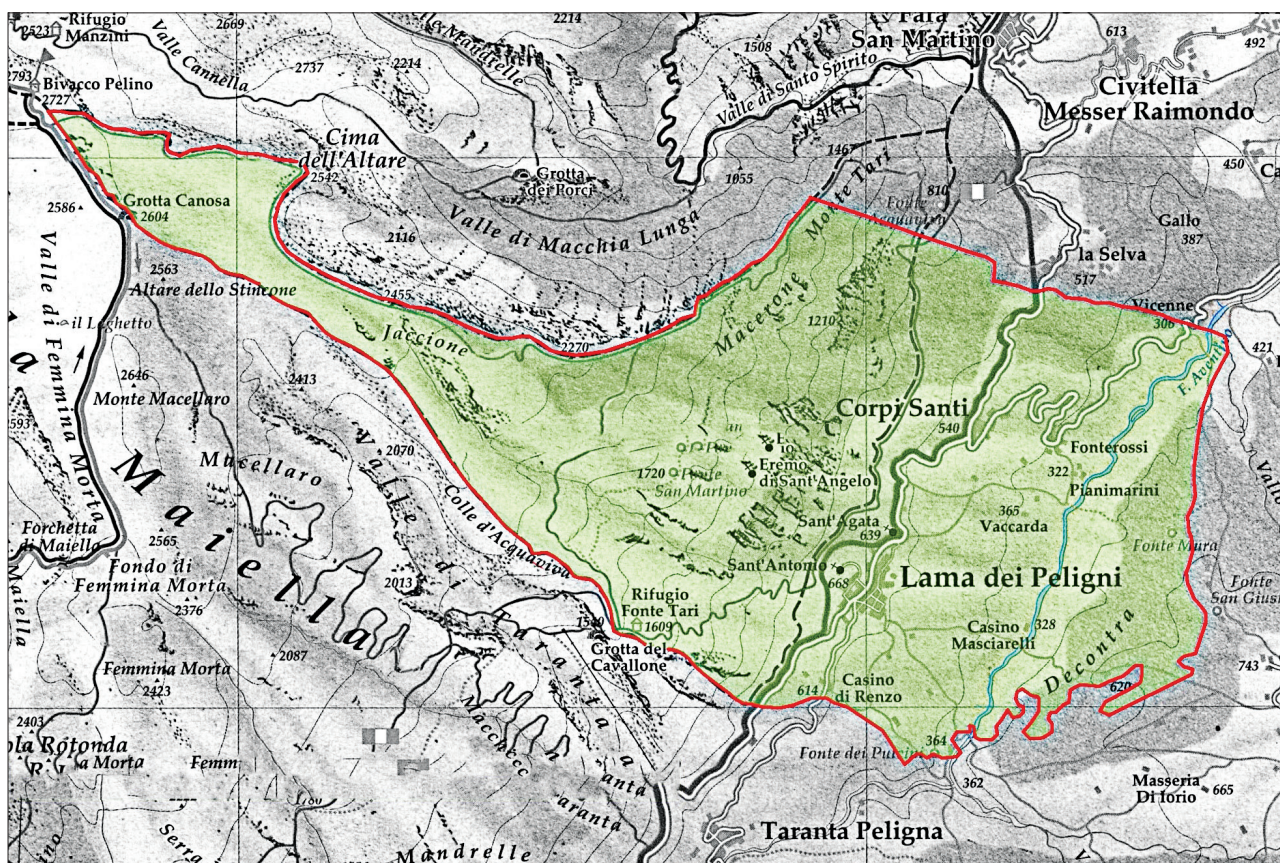


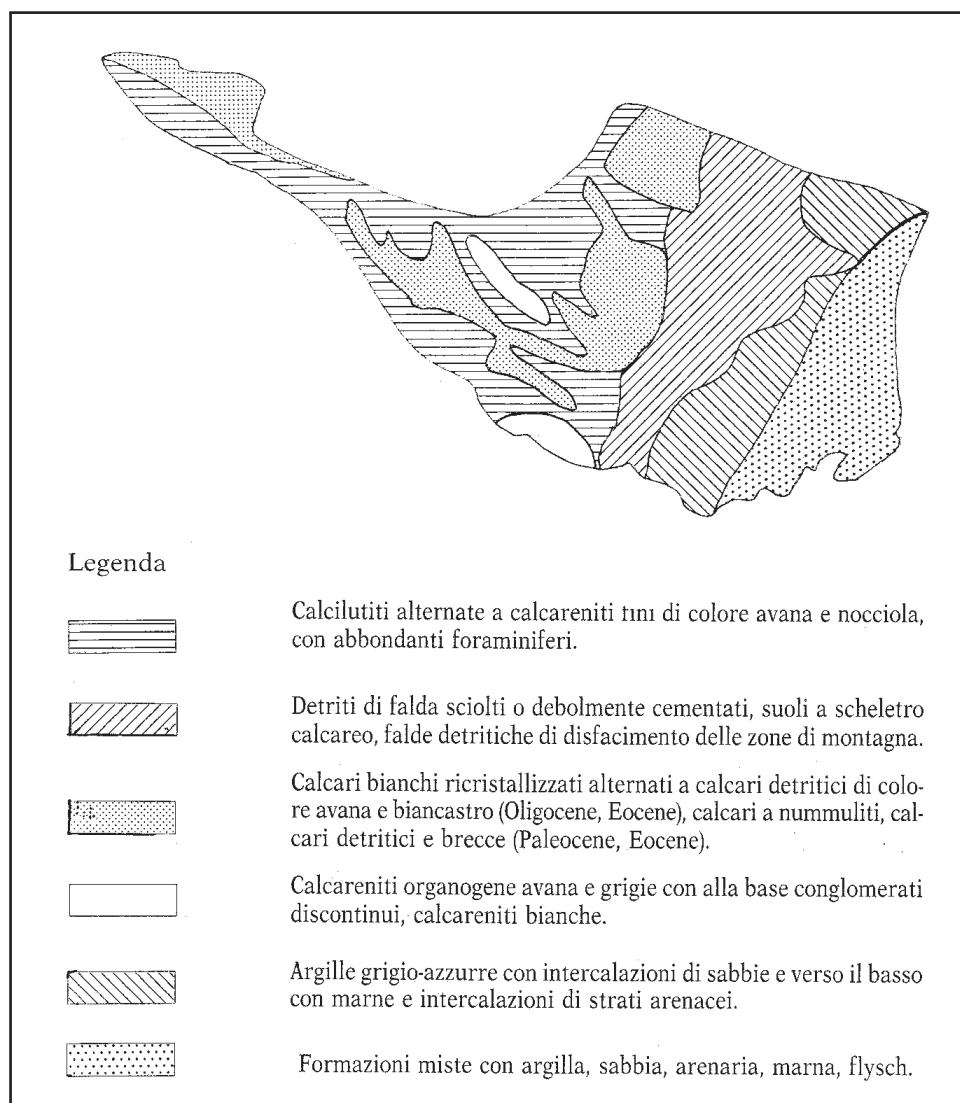
Fig. 1: Territorio di Lama dei Peligni (circondato dalla linea rossa).  
Sl. 1: Ozemlje občine Lama dei Peligni (obkroženo z rdečo črto).

Il massiccio della Majella ripara la parte bassa dai venti freddi settentrionali mentre risultano favoriti i venti provenienti da meridione e da Nord-Est. Tra questi la "Bora" chiamata localmente "Vuoijere" apportatrice di freddo ed anche neve.

- Nella Figura 3 è riportato l'andamento delle temperature e delle precipitazioni registrato nel centro abitato principale (altitudine m. 669).
- Il clima che si ha nel settore collinare ed abitato può essere definito submediterraneo di transizione con le seguenti caratteristiche termopluviometriche:
- temperatura media annua di circa 12°C
- temperatura media del mese più freddo (gennaio) di circa 4°C
- temperatura media del mese più caldo (agosto) con circa 23°C

- precipitazioni medie annue di circa 800 mm
- massimo di precipitazioni a novembre con circa 94 mm seguito da un massimo secondario in marzo con circa 71 mm
- minimo di precipitazioni in agosto con circa 39 mm
- stagione con precipitazioni più abbondanti: l'autunno con circa 244 mm
- stagione con precipitazioni minime: l'estate con circa 133 mm.

Le principali e più importanti formazioni vegetali che si rinvencono su tutto il territorio sono varie in quanto frutto dell'ampia escursione altitudinale, della varietà delle nicchie ecologiche, dei tipi di substrati e della pressione antropica di tempi passati esercitata con l'agricoltura ed il pascolo.



**Fig. 2: Carta geologica di Lama de Peligni. (Fonte: Pezzetta, 1991)**  
**Sl. 2: Geološka karta ozemlja občine Lama dei Peligni. (Vir: Pezzetta, 1991)**

Schematicamente si possono così riassumere:

- boschi igrofili ripariali disposti lungo le sponde del fiume Aventino;
- formazioni tipiche di ambienti umidi disposti presso le sorgenti, i fossi, i bordi di strade con ruscellamenti e le località con ristagno d'acqua;
- formazioni sinantropiche tipiche di campi coltivati ed abbandonati e, di aree marginali ed incolte situate presso le abitazioni;
- formazioni di prati aridi disposti su suoli a scheletro calcareo ed argilloso;
- formazioni di boscaglia termofila mista con rovere, orniello, carpino nero ed infiltrazioni qua e là di elementi mediterranei sclerofilli;
- formazione di faggeta termofila mista in località Valle di S. Angelo;
- formazioni miste glaericole poste a varie altitudini su rocce, ghiaioni, breccie e detriti vari;
- pinete a pino nero di rimboscimento artificiale;
- formazioni arboree miste di rimboscimento;
- formazioni miste arboreo-arbustive di orli stradali;
- prati aridi e pascoli montani di derivazione secondaria posti tra 1200-2200 metri di altitudine;
- formazioni arbustive altomontane a pino mugo e ginepro nano;
- praterie alpine continue ed a cuscinetto oltre 2200 metri d'altitudine.

#### MATERIALI E METODI

L'elenco floristico è stato realizzato tenendo conto delle ricerche sul campo realizzate dallo scrivente in modo più o meno occasionale a partire dal 1989, delle segnalazioni fornite dai responsabili del Parco Nazionale della Majella e dai botanici Aurelio Manzi e Daniele Di Santo e dei contributi alle ricerche botaniche locali ricavati dalle consultazioni bibliografiche.

In passato nell'area in esame hanno effettuato rilievi floristici: Tenore (1832), Cesati (1872), Feoli- hiapella

(1979-80), Tamaro (1986), Conti & Pellegrini (1990), Daiss & Daiss (1997), Ubaldi *et al.* (1998), Blasi *et al.* (2005), Di Fabrizio (2006), Frattaroli *et al.* (2006), Di Pietro *et al.* (2008) e Gottlich (2009).

Sono riportate segnalazioni floristiche anche in: Abbate (1903), Villani (1921), Caprara (1986), Pezzetta (1991), Manzi (1999, 2001, 2003 & 2006), Del Pizzo (1999) e Di Francesco (2004).

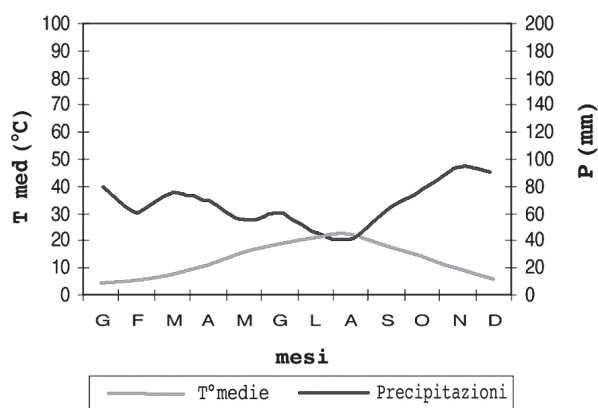
Per la nomenclatura dei vari taxa si è seguito Conti *et al.* (2005) ed esclusivamente per le Orchidaceae le indicazioni riportate nel recente volume sulle "Orchidee d'Italia" (GIROS, 2009).

Per l'assegnazione dei tipi corologici si è tenuto conto di quanto riportato in Pignatti (1982), Poldini (1991) e Pezzetta (2010). Inoltre per varie entità tenendo conto delle nuove segnalazioni e dell'attuale distribuzione geografica si è operata una nuova definizione del corotipo di appartenenza.

#### RISULTATI E DISCUSSIONE

Le ricerche effettuate hanno portato alla realizzazione del seguente elenco floristico.

1. *Abies alba* Mill. - Orofita Sud-Europeo
2. *Abies cephalonica* Loudon - Greco. Utilizzato per rimboscimenti\*\*
3. *Acer campestre* L. - Europeo-Caucasico\*
4. *Acer monspessulanus* L. subsp. *monspessulanus* - Eurimediterraneo\*
5. *Acer opalus* Mill. subsp. *obtusatum* (Waldst. & Kit. ex Willd.) Gams - Appennino-Balcanico
6. *Acer opalus* Mill. subsp. *Opalus* - Sud-Est-Europeo\*\*
7. *Acer pseudoplatanus* L. - Europeo-Caucasico
8. *Achillea ageratum* L. - Mediterraneo-Occidentale
9. *Achillea barrelieri* Ten. subsp. *barrelieri* - Endemico
10. *Achillea collina* Becker ex Rchb. - Sud-Est Europeo
11. *Achillea millefolium* L. subsp. *millefolium* - Euro-siberiano
12. *Achillea setacea* Waldst. & Kit. subsp. *setacea* - Sud-Est Europeo
13. *Achillea stricta* (W. D. J. Koch) Schleich. Ex Gremli - Orofita Sud-Europeo
14. *Achillea tenorii* Grande - Endemico
15. *Acinos alpinus* (L.) Moench subsp. *alpinus* - Orofita Sud-Europeo
16. *Actaea spicata* L. - Eurasiatico\*\*
17. *Adenostyles glabra* (Mill.) DC. subsp. *glabra* - Orofita Sud-Europeo
18. *Adiantum capillus veneris* L. - Pantropicale
19. *Adonis aestivalis* L. subsp. *aestivalis* - Eurasiatico\*
20. *Adonis annua* L. subsp. *annua* - Ovest-Europeo\*
21. *Adonis distorta* Ten. - Endemico
22. *Aethionema saxatile* (L.) R. Br. subsp. *saxatile* - Mediterraneo-Montano
23. *Agrimonia eupatoria* L. subsp. *eupatoria* - Subcomopolita



**Fig. 3: Climogramma di Lama dei Peligni.**  
**Sl. 3: Klimogram obćine Lama dei Peligni.**

24. *Agropyron repens* (L.) PB. - Circumboreale
25. *Agrostemma githago* L. - Eurasiatico\*
26. *Agrostis capillaris* L. - Circumboreale
27. *Ailanthus altissima* (Mill.) Swingle - Avventizio\*
28. *Ajuga reptans* L. - Europeo-Caucasico\*\*
29. *Alcea rosea* L. - coltivato\*
30. *Alchemilla colorata* Buser - Eurasiatico
31. *Allium cepa* L. - Ovest-Asiatico\*
32. *Allium dentiferum* Webb & Berthel. - Paleotemperato\*
33. *Allium lusitanicum* Lam. - Eurasiatico
34. *Allium moschatum* L. - Sud-Est-Europeo\*\*\*
35. *Allium sativum* L. - Asiatico Centro-Occidentale\*
36. *Allium sphaerocephalon* L. - Paleotemperato
37. *Allium ursinum* L. s.l. - Eurasiatico
38. *Alnus cordata* Loisel. (Loisel.) - Sud-Est Europeo\*\*
39. *Alnus glutinosa* L. Gaertn. - Paleotemperato\*\*
40. *Alyssum campestre* (L.) L. subsp. *strigosum* (Banks & Sol.) Jalas - Mediterraneo-Orientale
41. *Alyssum cuneifolium* Ten. subsp. *cuneifolium* - Endemico
42. *Alyssum diffusum* Ten. - Mediterraneo-Montano
43. *Alyssum montanum* L. subsp. *montanum* - Pontico
44. *Anthericum liliago* L. - Subatlantico\*\*
45. *Amaranthus retroflexus* L. - Cosmopolita
46. *Amelanchier ovalis* Medik. subsp. *ovalis* - Mediterraneo-Montano
47. *Anacamptis coriophora* (L.) R.M. Batheman, Pridgeon & M. W. Chase - Eurimediterraneo\*
48. *Anacamptis morio* (L.) R.M. Batheman, Pridgeon & M. W. Chase - Europeo-Caucasico
49. *Anacamptis pyramidalis* (L.) Rich. - Eurimediterraneo
50. *Anagallis arvensis* L. subsp. *arvensis* - Eurimediterraneo\*
51. *Anchusa azurea* Mill. - Eurimediterraneo\*\*
52. *Androsace mathildae* Levier - Endemico
53. *Androsace villosa* L. subsp. *villosa* - Eurasiatico
54. *Androsace vitaliana* (L.) Lapeyr. subsp. *praetutiana* (Sund.) Kress - Endemico
55. *Anemone apennina* L. subsp. *apennina* - Sud-Est Europeo\*\*
56. *Anemone hortensis* L. subsp. *hortensis* - Mediterraneo-Settentrionale
57. *Anemone narcissiflora* L. subsp. *narcissiflora* - Artico-Alpino
58. *Anemone nemorosa* L. - Circumboreale\*\*
59. *Anemone ranunculoides* L. - Europeo-Caucasico\*\*
60. *Anethum graveolens* L. - Asiatico\*
61. *Antennaria dioica* (L.) Gaertn. - Circumboreale\*\*
62. *Anthemis arvensis* L. subsp. *arvensis* - Subcosmopolita\*
63. *Anthemis cretica* L. subsp. *petraea* (Ten.) Oberprieler & Greuter - Endemico
64. *Anthoxanthum odoratum* L. subsp. *nipponicum* (Honda) Tzelev - Eurasiatico
65. *Anthyllis montana* L. subsp. *atropurpurea* (Vuk.) Pignatti - Mediterraneo-Montano
66. *Anthyllis vulneraria* L. subsp. *maura* (Beck) Maire - Stenomediterraneo
67. *Anthyllis vulneraria* L. subsp. *poliphylla* (DC.) Nyman - Sud-Est Europeo\*
68. *Anthyllis vulneraria* L. subsp. *pulchella* (Vis.) Bornm. - Sud-Est Europeo
69. *Anthyllis vulneraria* L. subsp. *rubiflora* (DC.) Arcang. - Eurimediterraneo
70. *Anthyllis vulneraria* L. subsp. *weldeniana* (Rchb.) Cullen - Appennino-Balcanico
71. *Aphanes arvensis* L. - Subcosmopolita\*\*
72. *Apium graveolens* L. - Paleotemperato\*
73. *Aquilegia magellensis* F. Conti & Soldano - Endemico
74. *Arabidopsis thaliana* (L.) Heynh. - Paleotemperato
75. *Arabis alpina* L. subsp. *alpina* - Artico-Alpino
76. *Arabis alpina* L. subsp. *caucasica* (Willd.) Briq. - Mediterraneo-Montano
77. *Arabis collina* Ten. subsp. *collina* - Mediterraneo-Montano
78. *Arabis surculosa* N. Terracc. - Appennino-Balcanico
79. *Arabis turrata* L. - Sud-Europeo
80. *Arctium lappa* L. - Eurasiatico\*
81. *Arctostaphylos uva-ursi* (L.) Spreng. - Artico-Alpino
82. *Arenaria bertoloni* Fiori - Endemico
83. *Arenaria grandiflora* L. subsp. *grandiflora* - Mediterraneo-Montano
84. *Arenaria serpyllifolia* L. subsp. *serpyllifolia* - Subcosmopolita
85. *Armeria canescens* (Host) Ebel - Sud-Europeo
86. *Armeria majellensis* Boiss. subsp. *majellensis* - Appennino-Balcanico
87. *Arrhenatherum elatius* (L.) P. Beauv. ex J. & C. Presl subsp. *elatius* - Paleotemperato
88. *Artemisia absinthium* L. - Subcosmopolita
89. *Artemisia alba* Turra - Eurimediterraneo
90. *Artemisia umbelliformis* Lam. subsp. *eriantha* (Ten.) Vallés-Xirau & Branas - Sud-Ovest Europeo
91. *Arum italicum* Mill. subsp. *italicum* - Stenomediterraneo\*
92. *Arundo donax* L. - Subcosmopolita\*
93. *Arundo plinii* Turra - Stenomediterraneo
94. *Asparagus acutifolius* L. - Stenomediterraneo
95. *Asperugo procumbens* L. - Paleotemperato\*
96. *Asperula aristata* L. s.l. - Mediterraneo-Montano
97. *Asperula cynanchica* L. - Eurimediterraneo
98. *Asperula purpurea* (L.) Ehrend. subsp. *purpurea* - Orofita Sud-Est Europeo
99. *Asphodeline lutea* (L.) Rchb. - Mediterraneo-Orientale\*\*
100. *Asphodelus macrocarpus* Parl. subsp. *macrocarpus* - Mediterraneo-Montano\*\*
101. *Asplenium fissum* Kit. ex Willd. - Orofita Sud-Est Europeo
102. *Asplenium lepidum* C. Presl subsp. *lepidum* - Orofita Sud-Est-Europeo

103. *Asplenium ruta muraria* L. s.l. - Circumboreale\*
104. *Asplenium trichomanes* L. s.l. - Cosmopolita
105. *Asplenium viride* Huds. - Circumboreale
106. *Aster alpinus* L. subsp. *alpinus* - Circumboreale
107. *Aster linosyris* L. Bernh. - Eurimediterraneo\*\*\*
108. *Astragalus australis* (L.) Lam. - Eurasiatico
109. *Astragalus depressus* L. subsp. *depressus* - Pontico
110. *Astragalus monspessulanus* L. subsp. *monspessulanus* - Eurimediterraneo\*
111. *Astragalus sempervirens* Lam. - Mediterraneo-Montano
112. *Astragalus sesameus* L. - Stenomediterraneo
113. *Astragalus siricinus* Ten. subsp. *siricinus* - Appennino-Balcanico
114. *Atriplex patula* L. - Circumboreale\*\*
115. *Atropa bella-donna* L. - Mediterraneo-Montano
116. *Aubrieta columnae* Guss. subsp. *columnae* - Endemico
117. *Avena barbata* Pott ex Link - Eurimediterraneo
118. *Avena fatua* L. - Eurasiatico
119. *Avena sativa* L. subsp. *sativa* - coltivato e spontaneizzato
120. *Avena sterilis* L. subsp. *sterilis* - Eurimediterraneo
121. *Avenula praetutiana* (Parl. ex Arcang.) Pignatti - Endemico
122. *Bellis perennis* L. - Circumboreale\*
123. *Bellis pusilla* (N. Terrac.) Pignatti - Orofita Sud-Est Europeo
124. *Berberis vulgaris* L. subsp. *vulgaris* - Eurasiatico
125. *Beta vulgaris* L. subsp. *vulgaris* - Eurimediterraneo (coltivato e spontaneizzato)\*
126. *Biscutella laevigata* L. subsp. *australis* Raffaelli & Baldoin - Endemico
127. *Bistorta vivipara* (L.) Delarbre - Artico-Alpino
128. *Bituminaria bituminosa* (L.) C. H. Stirt - Eurimediterraneo\*\*
129. *Blechnum spicant* (L.) Roth - Circumboreale
130. *Blackstonia perfoliata* (L.) Huds. subsp. *perfoliata* - Eurimediterraneo\*
131. *Bombacilaeana erecta* (L.) Smoljan - Eurosiberiano
132. *Borago officinalis* L. - Eurimediterraneo
133. *Botrychium lunaria* (L.) Sw. - Subcosmopolita
134. *Brachypodium genuense* (DC.) Roem. & Schult. - Orofita Sud-Europeo
135. *Brachypodium pinnatum* (L.) P. Beauv. - Eurasiatico
136. *Brachypodium rupestre* (Host) Roem. & Schult. - Subatlantico
137. *Brassica nigra* (L.) W. D. J. Koch - Eurimediterraneo
138. *Brassica oleracea* (L.) - Atlantico
139. *Brassica rapa* L. subsp. *rapa* - Eurimediterraneo
140. *Briza media* L. - Eurosiberiano\*\*
141. *Bromus arvensis* L. s.l. - Eurosiberiano
142. *Bromus erectus* Huds. subsp. *erectus* - Paleotemperato
143. *Bromus hordeaceus* L. subsp. *hordeaceus* - Cosmopolita
144. *Bromus squarrosus* L. - Paleotemperato
145. *Bromus sterilis* L. - Eurimediterraneo
146. *Bromus tectorum* L. subsp. *tectorum* - Paleotemperato
147. *Bryonia dioica* Jacq. - Eurimediterraneo
148. *Buglossoides arvensis* (L.) I. M. Johnst. - Eurimediterraneo
149. *Buglossoides purpureo-caerulea* (L.) I. M. Johnst. - Pontico\*\*
150. *Bunius eucago* L. - Eurimediterraneo
151. *Bupleurum baldense* Turra - Eurimediterraneo
152. *Buplerum falcatum* L. subsp. *cernuum* (Ten.) Arcang. - Eurasiatico
153. *Buplerum praealtum* L. - Pontico
154. *Calamintha nepeta* (L.) Savi subsp. *nepeta* - Mediterraneo-Montano
155. *Calendula arvensis* L. - Eurimediterraneo\*
156. *Campanula cochleariifolia* Lam. - Mediterraneo-Montano
157. *Campanula fragilis* Cirillo subsp. *cavolinii* Ten. - Endemico
158. *Campanula glomerata* L. - Eurasiatico
159. *Campanula rapunculus* L. - Paleotemperato
160. *Campanula scheuchzeri* Vill. subsp. *scheuchzeri* - Mediterraneo-Montano
161. *Campanula spicata* L. - Orofita Sud-Europeo
162. *Campanula tanfanii* Podlech - Endemico
163. *Capsella bursa-pastorii* (L.) Medik. subsp. *bursa-pastorii* - Cosmopolita
164. *Cardamine enneaphyllos* (L.) Crantz - Appennino-Balcanico
165. *Cardamine hirsuta* L. - Cosmopolita
166. *Cardamine monteluccii* Brilli-Catt. & Gubellini - Endemico\*\*
167. *Cardopatum corymbosum* (L.) Pers. - Appennino-Balcanico\*\*
168. *Carduus carlinifolius* Lam. subsp. *carlinifolius* - Mediterraneo-Montano
169. *Carduus chrysacanthus* Ten. subsp. *chrysacanthus* - Appennino-Balcanico
170. *Carduus nutans* L. subsp. *nutans* - Europeo-Occidentale
171. *Carduus pycnocephalus* L. subsp. *pycnocephalus* - Eurimediterraneo\*
172. *Carex caryophyllea* Latourr. - Eurasiatico
173. *Carex flacca* Schreb. subsp. *flacca* - Europeo
174. *Carex humilis* Leyss. - Eurasiatico
175. *Carex kitaibeliana* Degen ex Beck. subsp. *kitaibeliana* - Appennino-Balcanico
176. *Carex macrolepis* DC. - Appennino-Balcanico
177. *Carex parviflora* Host - Mediterraneo-Montano
178. *Carex pendula* Huds. - Eurasiatico
179. *Carlina acaulis* L. subsp. *caulescens* (Lam.) Schubl. & G. Martens - Europeo
180. *Carlina corymbosa* L. - Stenomediterraneo
181. *Carlina lanata* L. - Stenomediterraneo
182. *Carlina vulgaris* L. subsp. *vulgaris* - Eurosiberiano

183. *Carpinus betulus* L. - Europeo
184. *Carpinus orientalis* Mill. subsp. *orientalis* - Pontico
185. *Carthamus lanatus* L. subsp. *lanatus* - Eurimediterraneo\*
186. *Carum flexuosum* (Ten.) Nyman - Appennino-Balcanico
187. *Catapodium rigidum* (L.) C. E. Hubb. ex Dony subsp. *rigidum* - Eurimediterraneo
188. *Cedrus atlantica* (Endl) Carrière - Sud-Ovest Mediterraneo - utilizzato per rimoboschimenti\*\*
189. *Cedrus libani* A. Richard - Sud-Est Mediterraneo - utilizzato per rimoboschimenti\*\*
190. *Centaurea ambigua* Guss. subsp. *ambigua* - Endemico
191. *Centaurea calcitrapa* L. - Eurimediterraneo\*\*
192. *Centaurea ceratophylla* Ten. subsp. *ceratophylla* - Endemico
193. *Centaurea jacea* L. s.l. - Eurasiatico\*\*
194. *Centaurea solstitialis* L. subsp. *solstitialis* - Stenomediterraneo\*\*
195. *Centaurea tenoreana* Willk. - Endemico
196. *Centranthus angustifolius* (Mill.) DC. subsp. *angustifolius* - Mediterraneo-Occidentale
197. *Centranthus ruber* (L.) DC. subsp. *ruber* - Stenomediterraneo
198. *Centaurea erythraea* Rafn subsp. *erythraea* - Paleotemperato
199. *Cephalanthera damasonium* (Mill.) Druce - Eurimediterraneo\*
200. *Cephalanthera longifolia* (L.) Fritsch - Eurasiatico
201. *Cephalanthera rubra* (L.) Rich. - Eurasiatico\*\*
202. *Cephalaria leucantha* (L.) Roem. & Schult. - Eurimediterraneo
203. *Cerastium arvense* L. subsp. *arvense* - Paleotemperato
204. *Cerastium arvense* L. subsp. *suffruticosum* (L.) Ces. - Orofita Sud-Europeo
205. *Cerastium brachypetalum* Desp. ex Pers. subsp. *brachypetalum* - Eurimediterraneo
206. *Cerastium cerastoides* (L.) Britton - Artico-Alpino
207. *Cerastium pumilum* Curtis - Eurimediterraneo
208. *Cerastium thomasi* Ten. - Endemico
209. *Cerastium tomentosum* L. - Europeo-Occidentale
210. *Cercis siliquastrum* L. subsp. *siliquastrum* - Pontico
211. *Ceterach officinarum* s.l. Willd. - Eurasiatico
212. *Chaenorhinum minus* (L.) Lange subsp. *minus* - Eurimediterraneo
213. *Chelidonium majus* L. - Eurasiatico\*
214. *Chenopodium album* L. subsp. *album* - Cosmopolita\*
215. *Chenopodium bonus-henricus* L. - Circumboreale
216. *Chondrilla juncea* L. - Eurosiberiano\*
217. *Cicer arietinum* L. - Pontico - coltivato e spontaneizzato
218. *Cichorium endivia* L. subsp. *pumilum* (Jacq.) Cout. - Stenomediterraneo
219. *Cichorium intybus* L. subsp. *Intybus* - Paleotemperato
220. *Cirsium acaule* Scop. subsp. *Acaule* - Subatlantico
221. *Cirsium arvense* (L.) Scop. - Eurasiatico
222. *Cirsium lobelii* Ten. - Endemico; segnalato da Tenore nei pressi del Fiume Aventino e da confermare.
223. *Cirsium tenoreanum* Petr. - Endemico
224. *Cirsium vulgare* (Savi) Ten. - Paleotemperato
225. *Cistus creticus* L. subsp. *eriocephalus* (Viv.) Greuter & Burdet - Stenomediterraneo
226. *Cistus salviifolius* L. - Stenomediterraneo\*
227. *Clematis flammula* L. - Eurimediterraneo
228. *Clematis vitalba* L. - Europeo
229. *Clinopodium vulgare* L. subsp. *vulgare* - Circumboreale
230. *Clypeola jonthlaspi* L. subsp. *jonthlaspi* - Stenomediterraneo
231. *Colutea arborescens* L. - Eurimediterraneo
232. *Conium maculatum* L. subsp. *maculatum* - Eurimediterraneo\*\*
233. *Consolida regalis* Gray subsp. *regalis* - Eurimediterraneo\*\*
234. *Convolvulus arvensis* L. - Paleotemperato
235. *Convolvulus cantabrica* L. - Eurimediterraneo
236. *Cornus mas* L. - Pontico\*
237. *Cornus sanguinea* subsp. *hungarica* (Kàrpàti) Soò - Eurasiatico
238. *Coronilla minima* L. subsp. *minima* - Mediterraneo-Occidentale
239. *Coronilla scorpioides* (L.) W. D. J. Koch - Eurimediterraneo
240. *Coronilla vaginalis* Lam. - Sud-Est Europeo
241. *Coronilla valentina* L. - Sud-Ovest Mediterraneo
242. *Corylus avellana* L. - Europeo\*
243. *Cota tinctoria* (L.) J. Gaj subsp. *tinctoria* - Pontico
244. *Cotoneaster integerrimus* Medik. - Pontico
245. *Crataegus monogyna* Jacq. - Paleotemperato
246. *Crepis aurea* (L.) Cass. subsp. *glabrescens* (Caruel) Arcang. - Appennino-Balcanico
247. *Crepis lacera* Ten. - Appennino-Balcanico
248. *Crepis magellensis* F. Conti & Uzunov - Endemico
249. *Crepis neglecta* L. - Eurimediterraneo
250. *Crepis pygmaea* L. subsp. *pygmaea* - Sud-Ovest Europeo
251. *Crepis sancta* (L.) Babç. subsp. *sancta* - Eurimediterraneo
252. *Crocus vernus* (L.) Hill subsp. *vernus* - Eurimediterraneo
253. *Crupina vulgaris* Cass. - Eurosiberiano
254. *Cupressus arizonica* Green - Nordamericano (utilizzato per rimboschimenti)\*\*
255. *Cupressus sempervirens* L. - Mediterraneo Orientale (coltivato)
256. *Cuscuta europaea* L. - Paleotemperato\*\*
257. *Cuscuta planiflora* Ten. - Eurimediterraneo
258. *Cyanus segetum* Hill - Stenomediterraneo\*
259. *Cyanus triumfettii* (All.) Dostal ex A. & D. Love - Europeo
260. *Cyclamen hederifolium* Aiton subsp. *hederifolium* - Stenomediterraneo\*\*

261. *Cyclamen repandum* Sm. subsp. *repandum* - Nord-Mediterraneo\*
262. *Cydonia oblonga* Mill. - Asiatico (coltivato e spontaneizzato)\*
263. *Cymbalaria muralis* Gaertn., B. Mey & Scherb. s.l. - Eurimediterraneo\*
264. *Cymbalaria pallida* (Ten.) Wettst. - Endemico
265. *Cynara cardunculus* L. subsp. *cardunculus* - Stenomediterraneo\*
266. *Cynara cardunculus* L. subsp. *scolymus* (L.) Hayek - Stenomediterraneo (coltivato e spontaneizzato)
267. *Cynodon dactylon* (L.) Pers. - Cosmopolita
268. *Cynoglossum magellense* Ten. - Endemico
269. *Cynoglottis barrellieri* (All.) Vural & Kit Tan. subsp. *barrellieri* - Appennino-Balcanico\*\*
270. *Cynosurus echinatus* L. - Eurimediterraneo
271. *Cyperus longus* L. - Paleotemperato\*
272. *Cytisophyllum sessilifolius* (L.) O. Lang - Sud-Ovest Europeo
273. *Cytisus spinescens* C. Presl - Appennino-Balcanico
274. *Cystopteris alpina* (Lam.) Desv. - Cosmopolita
275. *Cystopteris fragilis* (L.) Bernh. - Cosmopolita
276. *Dactylis glomerata* L. subsp. *glomerata* - Paleotemperato
277. *Dactylis glomerata* L. subsp. *hispanica* (Roth) Nyman - Stenomediterraneo
278. *Dactylorhiza maculata* L. Soò s.l. - Paleotemperato\*\*
279. *Dactylorhiza sambucina* (L.) Soò - Europeo\*\*
280. *Daphne laureola* L. - Atlantico
281. *Daphne mezereum* L. - Eurosiberiano\*\*
282. *Daphne oleoides* Schreb. - Eurimediterraneo
283. *Datura stramonium* L. subsp. *stramonium* - Cosmopolita
284. *Daucus broteri* Ten. - Appennino-Balcanico
285. *Daucus carota* L. s.l. - Paleotemperato
286. *Delphinium fissum* Waldst. & Kit. subsp. *fissum* - Eurasiatico
287. *Delphinium peregrinum* L. - Sud-Est Europeo
288. *Deschampsia flexuosa* (L.) Trin. subsp. *flexuosa* - Cosmopolita
289. *Dianthus carthusianorum* L. subsp. *tenorei* (Lacaita) Pignatti - Endemico
290. *Dianthus ciliatus* Guss. subsp. *ciliatus* - Appennino-Balcanico
291. *Dianthus longicaulis* Ten. - Stenomediterraneo
292. *Dianthus monspessulanus* L. - Europeo
293. *Dianthus sylvestris* Wulfen subsp. *sylvestris* - Mediterraneo-Montano
294. *Dipsacus fullonum* L. - Eurimediterraneo
295. *Digitalis ferruginea* L. - Nord-Est Mediterraneo\*\*
296. *Digitalis lutea* L. subsp. *australis* (Ten.) Arcang. - Endemico
297. *Diplotaxis eruroides* (L.) DC. subsp. *eruroides* - Stenomediterraneo\*
298. *Diplotaxis tenuifolia* (L.) DC. - Subatlantico\*
299. *Doronicum columnae* Ten. - Mediterraneo-Montano
300. *Dorycnium hirsutum* (L.) Ser. - Eurimediterraneo\*\*
301. *Draba aizoides* L. subsp. *aizoides* - Mediterraneo-Montano
302. *Draba aspera* Bertol. - Mediterraneo-Montano
303. *Dryas octopetala* L. subsp. *octopetala* - Artico-Alpino
304. *Dryopteris filix mas* (L.) Schott - Cosmopolita
305. *Drypis spinosa* L. subsp. *spinosa* - Appennino-Balcanico
306. *Ecballium elaterium* (L.) A. Rich. - Eurimediterraneo
307. *Echinops ritro* L. subsp. *ritro* - Stenomediterraneo
308. *Echium italicum* L. subsp. *italicum* - Eurimediterraneo\*
309. *Echium plantagineum* L. - Eurimediterraneo\*
310. *Echium vulgare* L. s.l. - Europeo\*
311. *Edraianthus graminifolius* (L.) A. DC. subsp. *graminifolius* - Appennino-Balcanico
312. *Emerus majus* Mill. subsp. *emeroides* (Boiss. & Spruner) Soldano & F. Conti - Pontico
313. *Epilobium alsinifolium* Vill. - Artico-Alpino
314. *Epilobium hirsutum* L. - Paleotemperato\*
315. *Epilobium tetragonum* L. subsp. *tetragonum* - Eurimediterraneo
316. *Epipactis atrorubens* (Hoffm. ex Bernh.) Besser - Europeo\*
317. *Epipactis helleborine* (L.) Crantz subsp. *helleborine* - Paleotemperato
318. *Epipactis helleborine* (L.) Crantz subsp. *latina* W. Rossi & E. Klein - Stenomediterraneo\*
319. *Epipactis microphylla* (Ehrh.) Sw. - Europeo\*
320. *Equisetum arvense* L. subsp. *arvense* - Circumboreale\*
321. *Equisetum ramosissimum* Desf. - Circumboreale\*
322. *Equisetum telemateja* Ehrh. - Circumboreale\*
323. *Erigeron alpinus* L. subsp. *alpinus* - Eurasiatico
324. *Erigeron bonariensis* L. - Americano
325. *Erigeron epiroticus* (Vier.) Halácsy - Appennino-Balcanico
326. *Erigeron sumatrensis* Retz. - Americano
327. *Erinus alpinus* L. - Mediterraneo-Montano
328. *Erodium alpinum* L'Hér. - Endemico
329. *Erodium cicutarium* (L.) L'Hér. - Cosmopolita\*
330. *Erodium malacoides* (L.) L'Hér. - Eurimediterraneo
331. *Erophila verna* (L.) DC. subsp. *verna* - Circumboreale\*
332. *Eruca sativa* (Mill.) - Eurimediterraneo\*
333. *Eryngium amethystinum* L. - Sud-Est Europeo
334. *Eryngium campestre* L. - Eurimediterraneo\*\*
335. *Erysimum majellense* Polatscheck - Endemico
336. *Erysimum pseudorhaeticum* Polatscheck - Endemico
337. *Euonymus europaeus* L. - Eurasiatico
338. *Eupatorium cannabinum* L. subsp. *cannabinum* - Paleotemperato
339. *Euphorbia amygdaloides* L. subsp. *amygdaloides* - Europeo

340. *Euphorbia characias* L. - Stenomediterraneo  
 341. *Euphorbia cyparissias* L. - Europeo  
 342. *Euphorbia helioscopia* L. subsp. *helioscopia* - Cosmopolita\*  
 343. *Euphorbia myrsinites* L. subsp. *myrsinites* - Pontico  
 344. *Euphorbia nicaensis* All. s.l. - Eurimediterraneo  
 345. *Euphrasia italica* Wettst. - Endemico  
 346. *Euphrasia salisburgensis* Funck ex Hoppe - Europeo  
 347. *Euphrasia stricta* D. Wolff. Ex J. F. Lehm. - Europeo  
 348. *Fagus sylvatica* L. subsp. *sylvatica* - Europeo  
 349. *Ferula glauca* L. - Stenomediterraneo\*\*  
 350. *Festuca alfrediana* Foggi & Signorini - Appennino-Balcanico  
 351. *Festuca circummediterranea* Patzke - Eurimediterraneo  
 352. *Festuca dimorpha* Guss. - Nord-Ovest Mediterraneo-Montano  
 353. *Festuca inops* De Not. - Endemico  
 354. *Festuca laevigata* subsp. *crassifolia* (Gaudin) Kerguélen & Plonka - Orof. Sud-Ovest Europeo  
 355. *Festuca ovina* L. s.l. - Europeo  
 356. *Festuca robustifolia* Markgr.-Dann. - Endemico  
 357. *Festuca rubra* L. subsp. *commutata* (Gaudin) Markgr.-Dann. - Circumboreale  
 358. *Festuca violacea* Schleich. ex Gaudin subsp. *italica* Foggi, Graz, Rossi & Signorini - Endemico  
 359. *Fibigia clypeata* (L.) Medik - Orof. Sud-Est Europeo  
 360. *Ficus carica* L. - Eurimediterraneo (coltivato e spontaneizzato)  
 361. *Filipendula ulmaria* (L.) Maxim. - Eurosiberiano\*\*  
 362. *Foeniculum vulgare* Mill. - Eurimediterraneo\*  
 363. *Fragaria vesca* L. subsp. *vesca* - Eurosiberiano\*  
 364. *Fraxinus ornus* L. subsp. *ornus* - Pontico  
 365. *Fumana ericoids* (Cav.) Gand. - Stenomediterraneo\*  
 366. *Fumana procumbens* (Dunal) Gren. & Godr. s.l. - Pontico\*  
 367. *Fumana thymifolia* (L.) Spach ex Webb. - Stenomediterraneo\*  
 368. *Fumaria capreolata* L. subsp. *capreolata* - Eurimediterraneo\*  
 369. *Fumaria officinalis* L. s.l. - Paleotemperato\*  
 370. *Fumaria vaillantii* Loisel. - Eurimediterraneo  
 371. *Gagea villosa* (M. Bieb.) Sweet - Eurasiatico\*\*  
 372. *Galanthus nivalis* L. - Sud-Est Europeo  
 373. *Galega officinalis* L. - Pontico\*  
 374. *Galeopsis angustifolia* Hoffm. subsp. *angustifolia* - Eurimediterraneo\*\*  
 375. *Galium aparine* L. - Eurasiatico\*  
 376. *Galium anisophyllum* Vill. - Mediterraneo-Montano  
 377. *Galium lucidum* All. subsp. *lucidum* - Eurimediterraneo  
 378. *Galium magellense* Ten. - Endemico  
 379. *Galium mollugo* L. subsp. *erectum* Syme - Eurasiatico  
 380. *Galium mollugo* L. subsp. *mollugo* - Eurasiatico  
 381. *Galium rotundifolium* L. subsp. *rotundifolium* - Eurasiatico  
 382. *Galium verum* L. subsp. *verum* - Eurasiatico  
 383. *Genista sagittalis* L. - Europeo  
 384. *Genista tinctoria* L. - Eurasiatico  
 385. *Gentiana dinarica* Beck - Appennino-Balcanico  
 386. *Gentiana lutea* L. subsp. *lutea* - Orofita Sud-Europeo  
 387. *Gentiana magellensis* (Vaccari L.) Tammaro - Endemico  
 388. *Gentiana nivalis* L. - Artico-Alpino  
 389. *Gentiana verna* L. subsp. *verna* - Eurasiatico  
 390. *Gentianella columnae* (Ten.) Holub - Endemico\*\*  
 391. *Gentianopsis ciliata* (L.) Ma subsp. *ciliata* - Mediterraneo-Montano\*\*  
 392. *Geranium molle* L. - Eurasiatico  
 393. *Geranium nodosum* L. - Mediterraneo-Montano\*\*  
 394. *Geranium pusillum* L. - Europeo  
 395. *Geranium pyrenaicum* Burm. f. subsp. *pyrenaicum* - Eurimediterraneo  
 396. *Geranium robertianum* L. - Cosmopolita  
 397. *Gladiolus italicus* Mill. - Eurimediterraneo\*  
 398. *Glebionis coronaria* (L.) Spach - Stenomediterraneo\*  
 399. *Globularia bisnagarica* L. - Mediterraneo-Montano\*\*  
 400. *Globularia meridionalis* (Podp.) O. Schwarz. - Appennino-Balcanico  
 401. *Gnaphalium hoppeanum* W. D. J. Koch subsp. *magellense* (Fiori) Strid - Appennino-Balcanico  
 402. *Gymnadenia conopsea* (L.) R. Br. in W. T. Aiton - Eurasiatico  
 403. *Gypsophila repens* L. - Mediterraneo-Montano  
 404. *Hedera helix* L. subsp. *helix* - Mediterraneo-Atlantico  
 405. *Helianthemum apeninum* (L.) Mill. subsp. *apeninum* - Sud-Ovest Europeo  
 406. *Helianthemum nummularium* (L.) Mill. subsp. *grandiflorum* (Scop.) Schinz & Thell. - Europeo-Caucasico  
 407. *Helianthemum nummularium* (L.) Mill. subsp. *obscurum* (Celak) Holub - Europeo-Caucasico  
 408. *Helianthemum oleandicum* (L.) Dum. Cours. subsp. *alpestre* (Jacq.) Ces. - Orofita Sud-Europeo  
 409. *Helianthemum oleandicum* (L.) Dum. Cours. subsp. *incanum* (Willk.) G. Lopez - Europeo-Caucasico  
 410. *Helianthus tuberosus* L. - Nordamericano\*\*  
 411. *Helichrysum italicum* (Roth) G. Don subsp. *italicum* - Eurimediterraneo  
 412. *Heliotropium europaeum* L. - Eurimediterraneo  
 413. *Helleborus foetidus* L. subsp. *foetidus* - Subatlantico  
 414. *Helminthotheca echioides* (L.) Holub - Eurimediterraneo  
 415. *Herniaria bornmuelleri* Chaudhri - Endemico  
 416. *Herniaria incana* Lam. - Eurimediterraneo  
 417. *Hepatica nobilis* Schreb. - Circumboreale

418. *Hieracium amplexicaule* L. - Mediterraneo-Montano  
 419. *Hieracium lactucella* Wallr. - Europeo  
 420. *Hieracium naegelianum* Pancic - Appennino-Balcanico  
 421. *Hieracium pilosella* L. - Europeo  
 422. *Hieracium racemosum* Waldst. & Kit. ex Willd. subsp. *pulmonarifolium* - Europeo-Caucasico  
 423. *Hieracium zizianum* Tausch - Europeo  
 424. *Himantoglossum adriaticum* H. Baumann - Eurimediterraneo  
 425. *Hippocrepis comosa* L. subsp. *comosa* - Europeo  
 426. *Hordeum murinum* L. subsp. *murinum* - Circumboreale  
 427. *Hordeum vulgare* L. - (Africano?) coltivato ed inselvatichito  
 428. *Hornungia alpina* (L.) O. Appel subsp. *alpina* - Mediterraneo-Montano  
 429. *Hornungia petraea* (L.) Rchb. subsp. *petraea* - Eurimediterraneo  
 430. *Hyoschamus albus* L. - Eurimediterraneo  
 431. *Hypericum perforatum* L. - Eurimediterraneo  
 432. *Hypericum richeri* Vill. subsp. *richeri* - Orofita Sud-Europeo  
 433. *Hypochaeris achyrophorus* L. - Stenomediterraneo  
 434. *Hyssopus officinalis* L. subsp. *aristatus* (Godr.) Nyman - Eurasiatico  
 435. *Iberis carnosa* Willd. subsp. *carnosa* - Mediterraneo-Montano  
 436. *Iberis saxatilis* L. subsp. *saxatilis* - Mediterraneo-Montano  
 437. *Ilex aquifolium* L. - Subatlantico  
 438. *Inula conyzae* (Griess.) Meikle - Europeo  
 439. *Inula montana* L. - Mediterraneo-Montano  
 440. *Iris germanica* L. - Avventizio  
 441. *Iris germanica* L. var. *fiorentina* Dikes - Avventizio  
 442. *Iris marsica* I. Ricci & Colas. - Endemico\*\*\*  
 443. *Isatis apennina* Ten. ex Grande - Orofita Sud-Ovest Europeo (presente in Italia e Francia)  
 444. *Isatis tinctoria* L. subsp. *tinctoria* - Eurasiatico  
 445. *Juglans regia* L. - Asiatico (coltivato e spontaneizzato)  
 446. *Juncus inflexus* L. - Paleotemperato\*  
 447. *Juncus trifidus* (L.) subsp. *monanthos* (Jacq.) Asch. & Graebn. - Artico-Alpino  
 448. *Juniperus communis* L. subsp. *communis* - Circumboreale  
 449. *Juniperus communis* L. subsp. *alpina* (Neilr.) Celak - Artico-Alpino  
 450. *Juniperus oxycedrus* L. subsp. *oxycedrus* - Eurimediterraneo  
 451. *Juniperus sabina* L. - Circumboreale  
 452. *Jurinea mollis* (L.) Rchb. subsp. *mollis* - Sud-Est Europeo  
 453. *Kickxia spuria* (L.) Dumort. s.l. - Eurasiatico\*  
 454. *Knautia purpurea* (Vill.) Borbàs - Mediterraneo-Montano  
 455. *Kobresia myosuroides* (Vill.) Fiori - Artico-Alpino  
 456. *Koeleria lobata* (M. Bieb.) Roem. & Schult. - Mediterraneo-Montano  
 457. *Laburnum anagyroides* Medik. subsp. *anagyroides* - Eurimediterraneo  
 458. *Lactuca sativa* L. - coltivato e spontaneizzato\*  
 459. *Lactuca serriola* L. - Eurosiberiano  
 460. *Lactuca viminea* (L.) J. & C. Presl. subsp. *viminea* - Eurimediterraneo  
 461. *Lamium garganicum* L. subsp. *striatum* (Hayek) Sm. - Appennino-Balcanico  
 462. *Lamium maculatum* L. - Eurasiatico  
 463. *Laserpitium siler* L. subsp. *garganicum* (Ten.) Arcang. - Appennino-Balcanico  
 464. *Laserpitium siler* L. subsp. *siculum* (Spreng.) Santangelo, F. Conti & Gubellini - Endemico  
 465. *Lathyrus aphaca* L. subsp. *aphaca* - Eurimediterraneo\*\*\*  
 466. *Lathyrus cicera* L. - Eurimediterraneo\*  
 467. *Lathyrus hirsutus* L. - Eurimediterraneo  
 468. *Lathyrus nissolia* L. - Eurimediterraneo  
 469. *Lathyrus sativus* L. - Eurimediterraneo (coltivato e spontaneizzato)\*  
 470. *Lathyrus sylvestris* L. subsp. *sylvestris* - Europeo  
 471. *Lathyrus venetus* (Mill.) Wohlf. - Pontico  
 472. *Laurus nobilis* L. - Stenomediterraneo (coltivato e spontaneizzato)\*  
 473. *Legousia speculum-veneris* (L.) Chaix - Eurimediterraneo\*  
 474. *Leontodon cichoraceus* (Ten.) Sanguin. - Mediterraneo-Montano  
 475. *Leontodon crispus* Vill. subsp. *crispus* - Eurimediterraneo  
 476. *Leontodon hispidus* L. - Europeo  
 477. *Leontodon montanus* Lam. subsp. *melanotrichus* (Vierh.) Widder ex Pittoni - Orofita Sud-Est Europeo  
 478. *Leontodon montanus* Lam. subsp. *montanus* - Mediterraneo-Montano  
 479. *Leontodon rosanii* (Ten.) DC. - Endemico  
 480. *Leontopodium nivale* (Ten.) Huet ex Hand.-Mazz. - Appennino-Balcanico  
 481. *Lepidium draba* L. subsp. *draba* - Eurimediterraneo\*  
 482. *Leucanthemum tridactylites* (Kern. & Huter) Huter, Porta & Rigo - Endemico  
 483. *Leucanthemum vulgare* Lam. subsp. *vulgare* - Eurimediterraneo\*  
 484. *Ligusticum lucidum* Mill. subsp. *cuneifolium* (Guss.) Tammara - Endemico  
 485. *Ligustrum vulgare* L. - Europeo  
 486. *Lilium bulbiferum* L. subsp. *croceum* (Chaix) Jan - Orofita Centro-Europeo  
 487. *Lilium martagon* L. - Eurasiatico\*\*  
 488. *Limodorum abortivum* (L.) Sw. - Eurimediterraneo  
 489. *Linaria alpina* (L.) Mill. - Mediterraneo-Montano  
 490. *Linaria purpurea* (L.) Mill. - Endemico

491. *Linaria vulgaris* Mill. subsp. *vulgaris* - Eurasiatico  
 492. *Linum alpinum* Jacq. - Mediterraneo-Montano  
 493. *Linum bienne* Mill. - Subatlantico  
 494. *Linum capitatum* Kit. ex Schult. subsp. *serrulatum* (Bertol.) Hartvig - Appennino-Balcanico  
 495. *Linum strictum* L. s.l. - Stenomediterraneo  
 496. *Linum tenuifolium* L. - Pontico  
 497. *Linum tryginum* L. - Eurimediterraneo  
 498. *Listera ovata* (L.) R. Br. - Eurasiatico\*\*  
 499. *Lithospermum officinale* L. - Eurosiberiano\*\*  
 500. *Lomelosia crenata* (Cirillo) Greuter & Burdet subsp. *pseuditenensis* (Lacaita) Greuter & Burdet - Endemico  
 501. *Lomelosia graminifolia* subsp. *graminifolia* - Mediterraneo-Montano  
 502. *Lonicera caprifolium* L. - Pontico  
 503. *Lonicera etrusca* Santi - Eurimediterraneo\*\*  
 504. *Loranthus europaeus* Jacq. - Europeo  
 505. *Lotus corniculatus* L. subsp. *alpinus* (DC.) Rothm. - Mediterraneo-Montano  
 506. *Lunaria annua* L. - Sud-Est Europeo\*  
 507. *Lunaria rediviva* L. - Europeo\*\*  
 508. *Luzula campestris* (L.) DC. - Europeo  
 509. *Luzula spicata* (L.) DC. subsp. *italica* (Parl.) Arcang. - Endemico  
 510. *Lycopersicon esculentum* Miller - Americano (coltivato e spontaneizzato)  
 511. *Lythrum salicaria* L. - Cosmopolita\*\*\*  
 512. *Malcomia orsiniana* (Ten.) Ten. subsp. *orsiniana* - Appennino-Balcanico  
 513. *Malope malacoides* L. - Eurimediterraneo\*  
 514. *Malus domestica* (Borkh.) Borkh. - Asiatico (coltivato e spontaneizzato)  
 515. *Malva neglecta* Wallr. - Paleotemperato  
 516. *Malva pusilla* Sm. - Eurosiberiano  
 517. *Malva sylvestris* L. subsp. *sylvestris* - Eurosiberiano  
 518. *Mandragora autumnalis* Bertol. - Stenomediterraneo  
 519. *Mantisca salmantica* (L.) Briq. & Cavill. - Stenomediterraneo  
 520. *Marrubium incanum* Desr. - Sud-Est Europeo\*\*  
 521. *Marrubium peregrinum* L. - Sud-Est Europeo  
 522. *Matricaria chamomilla* L. - Subcosmopolita (coltivata e spontaneizzata)  
 523. *Matthiola incana* (L.) R. Br. subsp. *incana* - Stenomediterraneo  
 524. *Medicago falcata* L. subsp. *falcata* - Eurasiatico\*\*  
 525. *Medicago lupulina* L. - Paleotemperato  
 526. *Medicago minima* (L.) L. - Eurimediterraneo  
 527. *Medicago prostrata* Jacq. subsp. *prostrata* - Pontico  
 528. *Melampyrum barbatum* Wald. & Kit. subsp. *carstiense* Ronniger - Appennino-Balcanico  
 529. *Melampyrum italicum* Soò - Endemico\*\*  
 530. *Melica ciliata* L. subsp. *ciliata* - Eurimediterraneo  
 531. *Melica uniflora* Retz. - Paleotemperato  
 532. *Melilotus albus* Medik. - Eurasiatico  
 533. *Melittis melissophyllum* L. subsp. *melissophyllum* - Europeo  
 534. *Mentha longifolia* (L.) Huds. - Paleotemperato\*  
 535. *Mentha pulegium* L. subsp. *pulegium* - Eurimediterraneo  
 536. *Mercurialis annua* L. - Paleotemperato  
 537. *Mercurialis ovata* Sternb. & Hoppe - Pontico  
 538. *Mercurialis perennis* - Europeo\*\*  
 539. *Mespilus germanica* L. - Pontico  
 540. *Micromeria graeca* (L.) Benth. ex Rchb. subsp. *graeca* - Stenomediterraneo  
 541. *Micromeria juliana* (L.) Benth. Ex Rchb. - Stenomediterraneo\*\*  
 542. *Minuartia glomerata* (M. Bieb) Degen subsp. *trichocalycina* (Ten. & Guss.) F. Conti - Endemico  
 543. *Minuartia graminifolia* (Ard.) Jav. subsp. *clandestina* (Port. Mattf.) - Appennino-Balcanico  
 544. *Minuartia graminifolia* (Ard.) Jav. subsp. *rosani* (Ten.) Mattf. - Endemico  
 545. *Minuartia verna* (L.) Hiern subsp. *verna* - Eurasiatico  
 546. *Misopates orontium* (L.) Raf. subsp. *orontium* - Eurimediterraneo\*  
 547. *Monotropa hypopitys* L. - Circumboreale  
 548. *Morus alba* L. - Asiatico (coltivato e spontaneizzato)  
 549. *Morus nigra* L. - Asiatico (coltivato e spontaneizzato)  
 550. *Muscari comosum* (L.) Mill. - Eurimediterraneo\*\*  
 551. *Muscari neglectum* Guss. ex Ten. - Eurimediterraneo\*  
 552. *Myosotis alpestris* F. W. Schmidt - Mediterraneo-Montano  
 553. *Myosotis ambigens* (Bèg.) Grau - Endemico  
 554. *Myosotis incrassata* Guss. - Appennino-Balcanico\*\*  
 555. *Myosotis sylvatica* Hoffm. s.l. - Paleotemperato\*\*  
 556. *Narcissus poeticus* L. - Orofita Sud-Europeo\*\*  
 557. *Neotinea maculata* (Desf.) Stearn - Stenomediterraneo  
 558. *Neotinea tridentata* (Scop.) R. M. Bateman, Pridgeon & M.W. Chase - Eurimediterraneo\*\*  
 559. *Neotinea ustulata* (L.) R.M. Bateman, Pridgeon & M. W. Chase - Europeo-Caucasico\*\*  
 560. *Neottia nidus avis* (L.) Rich. - Eurasiatico  
 561. *Nigella damascena* L. - Eurimediterraneo  
 562. *Ocimum basilicum* L. - Asiatico (coltivato e spontaneizzato)  
 563. *Odontites luteus* (L.) Clairv. - Eurimediterraneo  
 564. *Odontites vulgaris* Moench subsp. *vulgaris* - Eurasiatico  
 565. *Olea europaea* L. - Stenomediterraneo (coltivato e spontaneizzato)  
 566. *Onobrychis alba* (Waldst. & Kit.) Desv. subsp. *alba* - Appennino-Balcanico  
 567. *Onobrychis caput-galli* (L.) Lam. - Stenomediterraneo  
 568. *Onobrychis viciifolia* Scop. - Mediterraneo-Montano

569. *Ononis cristata* Mill. subsp. *apennina* Tammaro & Catonica - Endemico  
 570. *Ononis pusilla* L. subsp. *pusilla* - Eurimediterraneo  
 571. *Ononis spinosa* L. subsp. *spinosa* - Eurimediterraneo  
 572. *Onopordum illyricum* L. subsp. *illyricum* - Stenomediterraneo\*\*  
 573. *Onosma echiodides* (L.) L. - Appennino-Balcanico  
 574. *Ophrys apifera* Huds. - Eurimediterraneo  
 575. *Ophrys bertoloni* Moretti - Appennino-Balcanico  
 576. *Ophrys bertoloniformis* O. & E. Danesch - Appennino-Balcanico  
 577. *Ophrys bombyliflora* Link - Stenomediterraneo  
 578. *Ophrys fuciflora* (F. W. Schmidt) subsp. *fuciflora* - Eurimediterraneo  
 579. *Ophrys fuciflora* (F. W. Schmidt) subsp. *tetraloniae* (W. P. Teschner) Kreutz - Appennino-Balcanico  
 580. *Ophrys incubacea* Bianca - Stenomediterraneo  
 581. *Ophrys lutea* Cav. subsp. *lutea* - Stenomediterraneo  
 582. *Ophrys promontorii* O. & E. Danesch - Endemico  
 583. *Ophrys sphegodes* Mill. subsp. *sphegodes* - Eurimediterraneo  
 584. *Opuntia ficus-indica* (L.) Mill. - Neotropica (coltivato e spontaneizzato)  
 585. *Orchis antropophora* (L.) All. - Mediterraneo-Atlantico\*  
 586. *Orchis italica* Poir. - Stenomediterraneo\*\*  
 587. *Orchis militaris* L. - Eurasiatico  
 588. *Orchis pauciflora* Ten. - Stenomediterraneo\*  
 589. *Orchis purpurea* Huds. - Eurasiatico  
 590. *Origanum majorana* L. - coltivato e spontaneizzato  
 591. *Origanum vulgare* L. subsp. *vulgare* - Eurasiatico  
 592. *Orlaya daucoide* (L.) Greuter - Stenomediterraneo  
 593. *Orlaya daucorlaya* Murb. - Appennino-Balcanico  
 594. *Ornithogalum comosum* L. - Mediterraneo-Montano\*\*  
 595. *Orobanchaceae caryophyllaceae* - Eurimediterraneo\*\*  
 596. *Orobanchaceae crenata* Forssk. - Eurimediterraneo\*\*  
 597. *Orthilia secunda* (L.) House - Circumboreale\*  
 598. *Ostrya carpinifolia* Scop. - Pontico  
 599. *Osyris alba* L. - Eurimediterraneo  
 600. *Oxytropis campestris* (L.) DC. subsp. *campestris* - Circumboreale  
 601. *Oxytropis neglecta* Ten. - Orofita Sud-Europeo  
 602. *Paliurus spina-christi* Mill. - Pontico  
 603. *Pallenia spinosa* (L.) Cass. subsp. *spinosa* - Eurimediterraneo  
 604. *Papaver alpinum* L. subsp. *ernesti mayeri* Markgr. - Endemico (presente anche in Slovenia)  
 605. *Papaver dubium* L. subsp. *dubium* - Eurimediterraneo  
 606. *Papaver hybridum* L. - Eurimediterraneo  
 607. *Papaver rhoeas* L. subsp. *rhoeas* - Mediterraneo-Orientale  
 608. *Papaver somniferum* L. - Subcosmopolita  
 609. *Parentucellia latifolia* (L.) Caruel - Eurimediterraneo  
 610. *Parietaria judaica* L. - Eurimediterraneo  
 611. *Parietaria officinalis* L. - Europeo  
 612. *Parnassia palustris* L. subsp. *palustris* - Eurosiberiano  
 613. *Paris quadrifolia* L. - Eurasiatico  
 614. *Paronychia kapela* (Hacq.) A. Kern. subsp. *kapela* - Appennino-Balcanico  
 615. *Pastinaca sativa* L. subsp. *urens* (Req. ex Godr.) Celak. - Subcosmopolita  
 616. *Pedicularis comosa* L. subsp. *comosa* - Mediterraneo-Montano  
 617. *Pedicularis elegans* Ten. - Endemico  
 618. *Pedicularis petolaris* Ten. - Appennino-Balcanico  
 619. *Petasites albus* (L.) Gaertn. - Europeo  
 620. *Petasites hybridus* (L.) P. Gaertn. B. Mey. & Scherb. subsp. *hybridus* - Eurasiatico  
 621. *Pethroragia prolifera* (L.) P. W. Ball & Heywood - Eurimediterraneo  
 622. *Pethroragia saxifraga* (L.) Link subsp. *saxifraga* - Eurimediterraneo  
 623. *Petroselinum crispum* (Mill.) Fuss - Eurimediterraneo  
 624. *Peucedanum oreoselinum* (L.) Moench - Europeo  
 625. *Phalaris canariensis* L. - Avventizio  
 626. *Phaseolus vulgaris* L. - Americano (coltivato e spontaneizzato)  
 627. *Phillyrea latifolia* L. - Stenomediterraneo\*  
 628. *Phleum alpinum* L. subsp. *rhaeticum* (Humphries) Rauschert - Europeo  
 629. *Phleum hirsutum* Honck. subsp. *ambiguum* (Ten.) Tzvelev - Mediterraneo-Montano  
 630. *Phragmites australis* (Cav.) Trin. ex Steud. subsp. *australis* - Cosmopolita  
 631. *Phyteuma orbiculare* L. - Mediterraneo-Montano  
 632. *Picris hieracioides* L. subsp. *hieracioides* - Eurosiberiano  
 633. *Pimpinella anisum* L. - Asiatico (coltivato e spontaneizzato)\*  
 634. *Pimpinella saxifraga* L. - Europeo  
 635. *Pimpinella tragium* Vill. - Eurimediterraneo  
 636. *Pinus halepensis* Mill. - Stenomediterraneo\*  
 637. *Pinus mugo* Turra subsp. *mugo* - Eurasiatico  
 638. *Pinus nigra* J. F. Arnold subsp. *nigra* - Sud-Europeo (utilizzato per rimboschimenti e spontaneizzato)  
 639. *Pinus pinea* L. - Eurimediterraneo (coltivato)\*  
 640. *Pistacia terebinthus* L. subsp. *terebinthus* - Eurimediterraneo\*  
 641. *Pisum sativum* L. subsp. *biflorum* (Raf.) Soldano - Eurimediterraneo  
 642. *Pisum sativum* L. subsp. *sativum* - Subcosmopolita (coltivato e spontaneizzato)  
 643. *Plantago atrata* Hoppe subsp. *atrata* - Mediterraneo-Montano  
 644. *Plantago lanceolata* L. - Eurasiatico  
 645. *Plantago major* L. s.l. - Eurasiatico  
 646. *Plantago media* L. subsp. *media* - Eurasiatico  
 647. *Plantago sempervirens* Crantz - Eurimediterraneo\*\*

648. *Platanthera bifolia* (L.) Rchb. - Paleotemperato\*\*  
 649. *Platanthera chlorantha* (Custer) Rchb. - Eurosiberiano\*  
 650. *Platanus orientalis* L. - Appennino-Balcanico (utilizzato per le alberature stradali)  
 651. *Plumbago europaea* L. - Stenomediterraneo  
 652. *Poa alpina* L. subsp. *alpina* - Circumboreale  
 653. *Poa annua* L. - Cosmopolita  
 654. *Poa badensis* Haenke ex Willd. - Mediterraneo-Montano  
 655. *Poa bulbosa* L. - Paleotemperato  
 656. *Poa molinerii* Balb. - Sud-Est Europeo  
 657. *Poa pratensis* L. - Circumboreale  
 658. *Poa trivialis* L. - Eurasiatico  
 659. *Polygala alpestris* Rchb. - Mediterraneo-Montano  
 660. *Polygala major* Jacq. - Pontico  
 661. *Polygala nicaensis* W. D. J. Koch subsp. *mediterranea* Chodat - Eurimediterraneo  
 662. *Polygonatum multiflorum* (L.) All. - Eurasiatico\*\*  
 663. *Polygonum aviculare* L. subsp. *aviculare* - Cosmopolita  
 664. *Polystichum lonchitis* (L.) Roth - Circumboreale  
 665. *Populus alba* L. - Paleotemperato\*  
 666. *Populus nigra* L. - Paleotemperato  
 667. *Populus tremula* L. - Eurosiberiano  
 668. *Potentilla caulescens* L. - Mediterraneo-Montano  
 669. *Potentilla crantzii* (Crantz) Beck ex Fritsch subsp. *crantzii* - Artico-Alpino  
 670. *Potentilla hirta* L. - Eurimediterraneo  
 671. *Potentilla rigoana* Th. Wolf - Endemico  
 672. *Potentilla tabernaemontani* Asch. - Europeo  
 673. *Prenanthes purpurea* L. - Europeo  
 674. *Primula auricula* L. subsp. *ciliata* (Moretti) Ludi - Mediterraneo-Montano  
 675. *Primula veris* L. subsp. *suaveolens* (Bertol.) Gutermann & Ehrend. - Eurimediterraneo  
 676. *Primula vulgaris* Huds. subsp. *vulgaris* - Europeo  
 677. *Prospero autumnale* (L) Speta subsp. *autumnale* - Eurimediterraneo\*\*  
 678. *Prunella laciniata* (L.) L. - Eurimediterraneo  
 679. *Prunus armeniaca* L. - Europeo-Caucasico (coltivato e spontaneizzato)  
 680. *Prunus avium* L. subsp. *avium* - Pontico  
 681. *Prunus cerasifera* Ehrh. - Pontico (coltivato e spontaneizzato)  
 682. *Prunus cerasus* L. - Pontico (coltivato e spontaneizzato)  
 683. *Prunus domestica* L. s.l. - Europeo-Caucasico (coltivato e spontaneizzato)  
 684. *Prunus dulcis* (Mill.) D. A. Webb - Eurimediterraneo  
 685. *Prunus mahaleb* L. - Pontico\*  
 686. *Prunus persica* (L.) Batsch - Asiatico (coltivato e spontaneizzato)  
 687. *Prunus spinosa* L. subsp. *spinosa* - Europeo  
 688. *Pseudofumaria alba* (Mill.) Lidén subsp. *alba* - Appennino-Balcanico\*\*  
 689. *Pteridium aquilinum* (L.) Kuhn subsp. *aquilinum* - Cosmopolita\*  
 690. *Ptilostemon strictus* (Ten.) Greuter - Appennino-Balcanico  
 691. *Pulycaria dysenterica* (L.) Bernh. - Eurimediterraneo\*\*  
 692. *Pulmonaria apennina* Cristof. & Puppi - Endemico  
 693. *Pulsatilla alpina* (L.) Delarbre s.l. - Orofita Sud-Europeo  
 694. *Punica granatum* L. - Asiatico (coltivato e naturalizzato)  
 695. *Pyracantha coccinea* M. Roem. - Stenomediterraneo  
 696. *Pyrus communis* L. - Avventizio (coltivato e naturalizzato)  
 697. *Quercus cerris* L. - Eurimediterraneo  
 698. *Quercus ilex* L. subsp. *ilex* - Stenomediterraneo  
 699. *Quercus pubescens* Willd. subsp. *pubescens* - Pontico  
 700. *Ranunculus acris* L. subsp. *acris* - Cosmopolita  
 701. *Ranunculus apenninus* (Chiov.) Pignatti - Endemico  
 702. *Ranunculus arvensis* L. - Paleotemperato\*  
 703. *Ranunculus brevifolius* Ten. - Appennino-Balcanico  
 704. *Ranunculus breyninus* Crantz - Orof. Sud-Europeo  
 705. *Ranunculus bulbosus* L. - Eurasiatico  
 706. *Ranunculus* L. subsp. *ficaria* - Eurasiatico  
 707. *Ranunculus magellensis* Ten. - Endemico  
 708. *Ranunculus pollinensis* (N. Terracc.) Chiov. - Endemico  
 709. *Ranunculus sartorianus* Boiss. & Heldr. - Appennino-Balcanico  
 710. *Ranunculus seguierii* Vill. subsp. *seguierii* - Mediterraneo-Montano  
 711. *Rapistrum rugosum* (L.) Arcang. - Eurimediterraneo\*\*\*  
 712. *Reichardia picroides* (L.) Roth - Stenomediterraneo  
 713. *Reseda alba* L. subsp. *alba* - Eurimediterraneo\*  
 714. *Reseda lutea* L. subsp. *lutea* - Europeo  
 715. *Reseda luteola* L. - Circumboreale  
 716. *Rhagadiolus stellatus* (L.) Gaertn. - Eurimediterraneo  
 717. *Rhamnus alaternus* L. subsp. *alaternus* - Stenomediterraneo  
 718. *Rhamnus pumilus* Turra - Mediterraneo-Montano  
 719. *Rhamnus saxatilis* Jacq. subsp. *infectoria* (L.) P. Fournier - Sud-Est Europeo  
 720. *Rhinanthus alectorolophus* (Scop.) Pollich subsp. *alectorolophus* - Centro-Europeo  
 721. *Rhinanthus wettsteinii* (Sterneck) Soò - Endemico  
 722. *Robertia taraxacoides* (Loisel.) DC. - Endemico  
 723. *Robinia pseudacacia* L. - Nordamericano (diffusamente spontaneizzato)  
 724. *Rosa arvensis* Huds. - Mediterraneo-Atlantico  
 725. *Rosa canina* L. - Paleotemperato  
 726. *Rosa pendulina* L. - Mediterraneo-Montano  
 727. *Rosa sempervirens* L. - Stenomediterraneo  
 728. *Rosmarinus officinalis* L. - Stenomediterraneo (coltivato e spontaneizzato)

729. *Rubia peregrina* L. subsp. *peregrina* - Stenomediterraneo\*
730. *Rubia tinctorum* L. - Eurasiatico
731. *Rubus caesius* L. - Eurasiatico
732. *Rubus canescens* DC. - Eurimediterraneo; segnalato da Tenore come *Rubus dissectus*
733. *Rubus hirtus* Waldst. & Kit. - Europeo
734. *Rubus ulmifolius* Schott - Mediterraneo-Atlantico
735. *Rumex acetosa* L. subsp. *acetosa* - Circumboreale
736. *Rumex crispus* L. - Cosmopolita\*
737. *Rumex nebroides* Campd. - Appennino-Balcanico
738. *Rumex scutatus* L. subsp. *scutatus* - Mediterraneo-Montano
739. *Ruscus aculeatus* L. - Eurimediterraneo\*\*
740. *Ruta chalepensis* L. - Stenomediterraneo\*
741. *Sagina saginoides* (L.) H. Karst. subsp. *saginoides* - Artico-Alpino
742. *Salix alba* L. - Paleotemperato
743. *Salix eleagnos* Scop. subsp. *eleagnos* - Mediterraneo-Montano
744. *Salix purpurea* L. subsp. *purpurea* - Eurasiatico\*
745. *Salix retusa* L. - Europeo
746. *Salix triandra* L. subsp. *triandra* - Eurosiberiano
747. *Salvia glutinosa* L. - Eurasiatico\*\*
748. *Salvia officinalis* L. - Stenomediterraneo (coltivato e spontaneizzato)\*
749. *Salvia pratensis* L. subsp. *pratensis* - Eurimediterraneo
750. *Salvia sclarea* L. - Eurimediterraneo\*\*
751. *Sambucus ebulus* L. - Eurimediterraneo\*
752. *Sambucus nigra* L. - Europeo\*
753. *Sanguisorba minor* Scop. subsp. *balearica* (Bourg. Ex Nyman) Munoz, Garm. & C. Navarro - Sud-Ovest Europeo
754. *Sanicula europea* L. - Mediterraneo-Montano
755. *Santolina marchii* Arrigoni - Avventizio (coltivato e spontaneizzato)
756. *Saponaria ocymoides* L. subsp. *ocymoides* - Mediterraneo-Montano\*\*
757. *Saponaria officinalis* L. - Eurosiberiano\*\*
758. *Satureja hortensis* L. - Eurimediterraneo
759. *Satureja montana* L. subsp. *montana* - Orofita Sud-Europeo
760. *Satureja subspicata* Bartl. ex Vis. subsp. *liburnica* Silic - Appennino-Balcanico. Segnalato da Tenore nel 1830 come *Satureja hissopifolia* sulla Majella lamese nei pressi di Grotta delle Vacche e mai più ritrovata.
761. *Saxifraga adscendens* L. subsp. *adscendens* - Mediterraneo-Montano
762. *Saxifraga caesia* L. - Mediterraneo-Montano
763. *Saxifraga callosa* Sm. subsp. *callosa* - Orofita Sud-Ovest Europeo
764. *Saxifraga exarata* Vill. subsp. *ampullacea* (Ten.) D. A. Webb - Endemico
765. *Saxifraga granulata* L. subsp. *granulata* - Subatlantico\*\*
766. *Saxifraga italica* D. A. Webb - Endemico\*\*
767. *Saxifraga oppositifolia* L. subsp. *oppositifolia* - Artico-Alpino
768. *Saxifraga paniculata* Mill. - Artico-Alpino
769. *Saxifraga porophylla* Bertol. subsp. *porophylla* - Endemico
770. *Saxifraga rotundifolia* L. subsp. *rotundifolia* - Mediterraneo-Montano\*\*
771. *Saxifraga tridactylites* L. - Eurimediterraneo
772. *Scabiosa columbaria* L. subsp. *portae* (Huter) Hayek - Sud-Est Europeo
773. *Scabiosa holosericea* Bertol. - Endemico
774. *Scabiosa pyrenaica* All. - Sud-Ovest Europeo
775. *Scabiosa uniseta* Savi - Endemico
776. *Scandix pecten veneris* L. - Eurimediterraneo
777. *Scilla bifolia* L. - Europeo
778. *Scolymus hispanicus* L. - Eurimediterraneo
779. *Scorzonera laciniata* L. subsp. *laciniata* - Paleotemperato\*
780. *Scrophularia canina* L. subsp. *bicolor* (Sm.) Greuter - Eurimediterraneo
781. *Scrophularia hoppii* Koch - Orofita Sud-Europeo
782. *Securigera securidaca* (L.) Degen & Dorfl. - Eurimediterraneo
783. *Securigera varia* (L.) Lassen - Sud-Est Europeo\*\*
784. *Sedum acre* L. - Europeo
785. *Sedum album* L. - Eurimediterraneo
786. *Sedum annuum* L. - Artico-Alpino
787. *Sedum atratum* L. subsp. *atratum* - Mediterraneo-Montano
788. *Sedum dasyphyllum* L. - Eurimediterraneo
789. *Sedum hispanicum* L. - Pontico
790. *Sedum magellense* Ten. subsp. *magellense* - Endemico
791. *Sedum montanum* L. subsp. *montanum* - Mediterraneo-Montano
792. *Sedum rubens* L. - Eurimediterraneo (segnalato da Tenore nel 1830 e da confermare)
793. *Sedum rupestre* L. subsp. *rupestre* - Europeo
794. *Sedum sexangulare* L. - Europeo
795. *Sempervivum arachnoideum* L. - Mediterraneo-Montano
796. *Sempervivum tectorum* L. - Mediterraneo-Montano
797. *Senecio doronicum* (L.) L. - Mediterraneo-Montano
798. *Senecio scopoli* Hoppe & Hornsch. Ex Bluff & Fingerh. - Appennino-Balcanico
799. *Senecio squalidus* L. s.l. - Orofita Sud-Est Europeo
800. *Senecio vulgaris* L. - Eurimediterraneo
801. *Seseli montanum* L. subsp. *montanum* - Mediterraneo-Montano
802. *Seseli pallasii* Besser - Pontico
803. *Sesleria juncifolia* Suffren subsp. *juncifolia* - Appennino-Balcanico
804. *Sesleria kalnikensis* Jáv. - Appennino-Balcanico
805. *Sesleria nitida* Ten. - Endemico
806. *Setaria viridis* (L.) P. Beauv. subsp. *viridis* - Cosmopolita

807. *Sherardia arvensis* L. - Eurimediterraneo  
808. *Sibbaldia procumbens* L. - Artico-Alpino  
809. *Sideritis italica* (Mill.) Greuter & Burdet - Endemico  
810. *Silene acaulis* (L.) Jacq. subsp. *bryoides* (Jord.) Nyman - Artico-Alpino  
811. *Silene catholica* (L.) W. T. Aiton - Appennino-Balcanico  
812. *Silene cattariniana* Ferrarini & Cecchi - Endemico  
813. *Silene ciliata* Pourr. subsp. *graefferi* (Guss.) Nyman - Appennino-Balcanico  
814. *Silene conica* L. - Eurimediterraneo  
815. *Silene latifolia* Poir. subsp. *alba* (Mill.) Greuter & Burdet - Paleotemperato  
816. *Silene italica* (L.) Pers. subsp. *italica* - Eurimediterraneo  
817. *Silene multicaulis* Guss. subsp. *multicaulis* - Appennino-Balcanico  
818. *Silene nemoralis* Waldst. & Kit. - Eurimediterraneo  
819. *Silene notarisii* Ces. - Endemico  
820. *Silene otites* (L.) Wibel subsp. *otites* - Eurasiatico  
821. *Silene paradoxa* L. - Appennino-Balcanico  
822. *Silene pusilla* Waldst. & Kit. subsp. *pusilla* - Mediterraneo-Montano  
823. *Silene vulgaris* (Moench) Garcke subsp. *vulgaris* - Paleotemperato  
824. *Silybum marianum* (L.) Gaertn. - Eurimediterraneo\*  
825. *Sixalix atropurpurea* (L.) Greuter & Burdet subsp. *grandiflora* (Scop.) Soldano & F. Conti - Stenomediterraneo  
826. *Smilax aspera* L. - Stenomediterraneo  
827. *Solanum dulcamara* L. - Paleotemperato  
828. *Solanum tuberosum* L. - Sud-Americano (coltivato e spontaneizzato)  
829. *Solidago virgaurea* L. subsp. *virgaurea* - Circumboreale\*\*  
830. *Sorbus aria* (L.) Crantz subsp. *aria* - Paleotemperato  
831. *Sorbus aucuparia* L. s.l. - Europeo  
832. *Sorbus domestica* L. - Eurimediterraneo  
833. *Sorbus torminalis* (L.) Crantz - Eurasiatico  
834. *Spartium junceum* L. - Eurimediterraneo  
835. *Stachys germanica* L. subsp. *germanica* - Eurimediterraneo  
836. *Stachys germanica* L. subsp. *salviifolia* (Ten.) Gams. - Appennino-Balcanico  
837. *Stachys recta* L. subsp. *recta* - Mediterraneo-Montano  
838. *Stachys thirkei* C. Koch - Appennino-Balcanico  
839. *Stachys thymphaea* Hausskn. - Appennino-Balcanico  
840. *Stellaria media* (L.) Vill. subsp. *media* - Cosmopolita  
841. *Stenbergia lutea* (L.) Ker Gawl. ex Spreng. - Mediterraneo-Montano\*\*\*  
842. *Stipa dasyvaginata* Martinovsky subsp. *apennincola* Martinovsky & Moraldo - Endemico\*\*  
843. *Sulla coronaria* (L.) Medik. - Mediterraneo-Occidentale  
844. *Syringa vulgaris* L. - Mediterraneo-Montano  
845. *Tamarix gallica* L. - Eurimediterraneo\*\*  
846. *Tamus communis* L. - Eurimediterraneo\*\*  
847. *Tanacetum corymbosum* (L.) Sch. Bip. subsp. *corymbosum* - Eurimediterraneo  
848. *Taraxacum apenninum* (Ten.) Ten. - Endemico  
849. *Taraxacum glaciale* E. & A. Huet. ex Hand.-Mazz. - Appennino-Balcanico  
850. *Taraxacum laevigatum* (Willd.) DC. - Paleotemperato  
851. *Taraxacum officinale* Weber - Circumboreale  
852. *Taxus baccata* L. - Paleotemperato  
853. *Teucrium capitatum* L. subsp. *capitatum* - Stenomediterraneo  
854. *Teucrium chamaedrys* L. subsp. *chamaedrys* - Eurimediterraneo  
855. *Teucrium flavum* L. subsp. *flavum* - Stenomediterraneo  
856. *Teucrium montanum* L. - Mediterraneo-Montano  
857. *Teucrium polium* L. subsp. *polium* - Stenomediterraneo  
858. *Thalictrum minus* L. subsp. *minus* - Eurasiatico  
859. *Thesium humifusum* DC. - Eurimediterraneo  
860. *Thesium linophyllum* L. - Sud-Est Europeo  
861. *Thesium parnassii* A. DC. - Appennino-Balcanico  
862. *Thlaspi perfoliatum* L. subsp. *perfoliatum* - Paleotemperato  
863. *Thlaspi stylosum* (Ten.) Mutel - Endemico  
864. *Thymus glabrescens* Willd. subsp. *decipiens* (Heinr. Braun) Domin - Sud-Est-Europeo  
865. *Thymus longicaulis* C. Presl. subsp. *longicaulis* - Eurimediterraneo  
866. *Thymus praecox* Opiz subsp. *polytrichus* (Borbàs) Jalas - Appennino-Balcanico  
867. *Thymus vulgaris* L. subsp. *vulgaris* - Stenomediterraneo  
868. *Tilia cordata* Mill. - Europeo  
869. *Tilia platyphyllos* Scop. subsp. *platyphyllos* - Europeo  
870. *Tordylium apulum* L. - Stenomediterraneo\*\*\*  
871. *Trachynia distachya* (L.) Link - Stenomediterraneo\*\*\*  
872. *Trapogon porrifolius* L. subsp. *porrifolius* - Eurimediterraneo  
873. *Trapogon pratensis* L. s.l. - Eurosiberiano  
874. *Trifolium alexandrinum* L. - Eurimediterraneo (coltivato e spontaneizzato)\*\*\*  
875. *Trifolium alpestre* L. - Europeo  
876. *Trifolium arvense* L. subsp. *arvense* - Paleotemperato  
877. *Trifolium campestre* Schreb. - Paleotemperato  
878. *Trifolium fragiferum* L. subsp. *fragiferum* - Paleotemperato  
879. *Trifolium nigrescens* Viv. subsp. *nigrescens* - Eurimediterraneo  
880. *Trifolium noricum* Wulfen subsp. *praetutianum* (Savi) Arcang. - Appennino-Balcanico

881. *Trifolium ochroleucum* Huds. - Pontico  
 882. *Trifolium pratense* L. subsp. *pratense* - Eurasiatico  
 883. *Trifolium pratense* L. subsp. *semipurpureum* (Strobl) Pignatti - Endemico  
 884. *Trifolium repens* L. subsp. *repens* - Paleotemperato  
 885. *Trifolium scabrum* L. subsp. *scabrum* - Eurimediterraneo  
 886. *Trifolium stellatum* L. - Eurimediterraneo  
 887. *Trifolium thalii* Vill. - Mediterraneo-Montano  
 888. *Trigonella foenum-graecum* L. - Eurimediterraneo  
 889. *Trinia dalechampii* (Ten.) Janch. - Appennino-Balcanico  
 890. *Triticum aestivum* L. - coltivato e spontaneizzato  
 891. *Triticum turgidum* L. - coltivato e spontaneizzato  
 892. *Trollius europaeus* L. subsp. *europaeus* - Artico-Alpino  
 893. *Tusillago farfara* L. - Paleotemperato  
 894. *Typha latifolia* L. - Cosmopolita  
 895. *Ulmus minor* Mill. subsp. *minor* - Europeo-Caucasico  
 896. *Umbilicus horizontalis* (Guss.) DC. - Stenomediterraneo  
 897. *Urospermum dalechampii* (L.) F. W. Schmidt - Eurimediterraneo  
 898. *Urtica dioica* L. subsp. *dioica* - Cosmopolita  
 899. *Valeriana montana* L. - Mediterraneo-Montano  
 900. *Valeriana salunca* All. - Orofita Sud-Europeo  
 901. *Valeriana tripteris* L. subsp. *tripteris* - Mediterraneo-Montano  
 902. *Valeriana tuberosa* L. - Mediterraneo-Montano  
 903. *Valerianella carinata* Loisel. - Eurimediterraneo  
 904. *Veratrum nigrum* L. - Eurasiatico\*\*  
 905. *Verbascum blattaria* L. - Paleotemperato  
 906. *Verbascum longifolium* Ten. - Appennino-Balcanico  
 907. *Verbascum phlomoides* L. - Eurimediterraneo  
 908. *Verbascum thapsus* L. subsp. *thapsus* - Europeo  
 909. *Verbena officinalis* L. - Paleotemperato  
 910. *Veronica alpina* L. - Artico-Alpino  
 911. *Veronica anagallis-acquatica* L. subsp. *anagallis acquatica* - Cosmopolita  
 912. *Veronica aphylla* L. subsp. *aphylla* - Mediterraneo-Montano  
 913. *Veronica arvensis* L. - Cosmopolita  
 914. *Veronica beccabunga* L. - Eurasiatico  
 915. *Veronica hederifolia* L. subsp. *hederifolia* - Eurasiatico  
 916. *Veronica orsiniana* Ten. subsp. *orsiniana* - Orofita Sud-Europeo  
 917. *Veronica persica* Poir. - Eurasiatico  
 918. *Veronica praecox* All. - Eurimediterraneo  
 919. *Viburnum tinus* L. subsp. *tinus* - Stenomediterraneo  
 920. *Vicia cracca* L. - Eurasiatico  
 921. *Vicia disperma* DC. - Mediterraneo-Occidentale  
 922. *Vicia ervilia* (L.) Willd. - Eurimediterraneo  
 923. *Vicia faba* L. - coltivato e spontaneizzato  
 924. *Vicia hirsuta* (L.) Gray - Paleotemperato  
 925. *Vicia sativa* L. subsp. *sativa* - Eurimediterraneo\*\*\*  
 926. *Vicia narbonensis* L. subsp. *narbonensis* - Eurimediterraneo  
 927. *Vinca major* L. subsp. *major* - Eurimediterraneo\*  
 928. *Viola alba* Besser subsp. *dehnardii* (Ten.) W. Becker - Eurimediterraneo  
 929. *Viola eugeniae* Parl. subsp. *eugeniae* - Endemico  
 930. *Viola majellensis* Porta & Rigo ex Strobl - Appennino-Balcanico  
 931. *Viola odorata* L. - Eurimediterraneo  
 932. *Viola riechenbachiana* Jord. ex Boreau - Eurosiberiano  
 933. *Viscum album* L. subsp. *album* - Eurasiatico\*\*  
 934. *Vitis vinifera* L. subsp. *vinifera* - coltivato e spontaneizzato  
 935. *Xanthium strumarium* L. subsp. *strumarium* - Cosmopolita  
 936. *Xeranthemum cylindraceum* Sm. - (Eurasiatico) Sud-Europeo Sud-Siberiano  
 937. *Ziziphus zizyphus* (L.) Meikle - Coltivato

## Note:

- \* Specie nuova per Lama dei Peligni  
 \*\* Specie nuova per Lama dei Peligni (Di Santo Daniele in verbis)  
 \*\*\* Specie nuova per Lama dei Peligni (Manzi Aurelio in verbis)

L'inventario floristico sopra riportato, che si presume non completo, comprende entità appartenenti a 101 famiglie diverse di cui la più rappresentata è quella delle Compositae con 124 taxa. Seguono le Fabaceae con 74, le Poaceae con 59, le Caryophyllaceae con 44, le Rosaceae con 43, le Lamiaceae con 40, le Orchidaceae con 35 poi tutte le altre con valori decrescenti.

La prima considerazione da fare è che un'area che rappresenta solo lo 0,01 % dell'intero territorio italiano ospita circa il 12 % della flora nazionale costituita nel 2010 da 7953 taxa (Peruzzi, 2010).

Al fine di avere un'idea della biodiversità locale in termini numerici è stato utilizzato un indice (indicato con Id), scientificamente definito alphabiodiversità, che si ottiene dal rapporto tra i taxa totali censiti e la superficie d'indagine.

Nel caso in esame l'indice Id è = 30, un valore molto alto che conferma l'elevata ricchezza floristica della zona e di cui si apprezza maggiormente il suo significato se confrontato con quello ottenuto per altri ambiti geografici:

- Id Carso giuliano = 5.8 (Poldini, 2009)
- Id Friuli Venezia Giulia = 0.448 (Poldini, 2009)
- Id Parco della Majella = 3.37
- Id Abruzzo = 0.31
- Id Monte Argentario = 19.50

La flora lamese costituisce il 45% della flora dell'intero Comprensorio del Parco Nazionale della Majella che ammonta a 2118 taxa (Conti & Tinti, 2006) e circa

il 28 % della flora regionale dell'Abruzzo che al termine del 2010 risultava costituita da 3409 entità (Peruzzi, 2010).

L'elenco floristico non comprende nuove segnalazioni per l'Italia, l'Abruzzo ed il massiccio della Majella. Per il territorio lamese, invece, sono segnalati 207 nuovi taxa molti dei quali comunissimi e non riportati in precedenti dati di letteratura.

Nell'inventario floristico sono riportate 9 specie incluse nella lista rossa nazionale e 20 protette dalle leggi regionali abruzzesi tra cui: *Anemone apennina* subsp. *apennina*, *Aquilegia magellensis*, *Artemisia umbellifor-*

*mis* subsp. *eriantha*, *Atropa bella-donna*, *Daphne mezereum*, *Gentiana dinarica*, *Gentiana lutea* subsp. *lutea*, *Leontopodium nivale*, *Lilium bulbiferum* subsp. *croceum*, *Lilium martagon*, *Pinus mugo* subsp. *mugo*, *Ranunculus magellensis*, *Primula auricula* subsp. *ciliata*, *Primula veris* subsp. *veris*, *Trollius europaeus* subsp. *europaeus* e *Viola magellensis*.

Tabella 1 documenta una vasta gamma di entità di diversa origine e distribuzione geografica che da un lato confermano che l'area come il resto del massiccio della Majella e dell'Abruzzo rappresenta un crocevia di flussi floristici e dall'altro che le diverse condizioni climatiche

**Tab. 1: Corotipi della flora lamese.**

**Tab. 1: Geoelementi lameške flore.**

Elementi geografici	Numero taxa	%
<b>Endemico</b>	<b>75</b>	<b>8</b>
<b>Mediterraneo</b>	<b>338</b>	<b>36,07</b>
Eurimediterraneo	176	18,78
Mediterraneo-Montano	75	8
Stenomediterraneo	72	7,68
Nord-Mediterraneo	3	0,32
Mediterraneo-Occidentale	5	0,53
Mediterraneo-Orientale	4	0,42
SW & SE Mediterraneo	3	0,32
<b>Eurasiatico</b>	<b>199</b>	<b>21,23</b>
Eurasiatico s.s.	76	8,11
Europeo-Caucasico	13	1,39
Paleotemperato	55	5,97
Eurosiberiano	23	2,37
Pontico	32	3,11
<b>Europeo</b>	<b>180</b>	<b>19,21</b>
Europeo s.s.	54	5,76
Orofita Sud-Europeo	23	2,45
Europeo Occidentale	3	0,32
Sud-Ovest-Europeo	8	0,85
Sud-Est-Europeo	26	2,77
Centro-Europeo	2	0,21
Appennino-Balcanico	64	6,87
<b>Atlantico, Subatlantico &amp; Mediterraneo-Atlantico</b>	<b>14</b>	<b>1,49</b>
<b>Nordico</b>	<b>52</b>	<b>5,54</b>
Artico-Alpino	20	2,13
Circumboreale	32	3,41
<b>Cosmopolita &amp; Subcosmopolita</b>	<b>40</b>	<b>4,69</b>
<b>Coltivato</b>	<b>13</b>	<b>1,38</b>
<b>Avventizio</b>	<b>6</b>	<b>0,64</b>
<b>Extraeuropeo</b>	<b>20</b>	<b>2,13</b>
Asiatico	9	0,96
Americano	8	0,85
Neotropicale & Pantropicale	2	0,22

ed ambientali causate dall'ampia escursione altitudinale consentono l'adattamento di piante con diverse esigenze termiche ed ecologiche.

Il contingente floristico più rappresentativo è il Mediterraneo con 338 taxa, seguito dall'Eurasiatico con 199 taxa, dall'Europeo con 180 taxa e poi da tutti gli altri con valori minori.

Il contingente endemico con 8% dei taxa censiti è rappresentato da un valore percentuale superiore a quello nazionale ad ulteriore conferma dell'importanza naturalistica dell'area d'indagine. La maggior parte degli endemismi è collocata in alta montagna in ambienti estremi e molto specializzati con scarsa competizione vegetale quali gli ambiti glareicoli di rocce e macereti vari e le praterie alpine. Di questi *Crepis magellensis*, *Minuartia glomerata* subsp. *trichocalycina* ed *Aquilegia magellensis* sono esclusivi del massiccio della Majella.

Le seguenti specie endemiche sono esclusive dell'Abruzzo: *Alyssum cuneifolium* subsp. *cuneifolium*, *Anthemis carpatica* subsp. *petraea*, *Campanula fragilis* subsp. *cavolinii*, *Gentiana magellensis*, *Centaurea tenoreana*. *Biscutella laevigata* subsp. *australis* e *Androsace mathildae*.

Sono taxa endemici limitati a vari sistemi montuosi dell'Appennino centrale: *Adonis distorta*, *Androsace vitaliana* subsp. *praetutiana*, *Campanula tanfanii*, *Centaurea ceratophylla* subsp. *ceratophylla*, *Cymbalaria pallida*, *Galium magellense*, *Gentianella columnae*, *Iris marsica*, *Leucanthemum tridactylites*, *Ononis cristata* subsp. *apennina*, *Ranunculus magellensis*, *Saxifraga italica*, *Silene cattariniana* e *Silene notarisii*.

Le altre specie endemiche a loro volta hanno una distribuzione geografica più vasta lungo l'arco appenninico ed il territorio peninsulare.

Degni di nota sono anche i taxa dei corotipi Artico-Alpino ed Appennino-Balcanico costituiti da entità relittiche abbastanza rare che testimoniano i movimenti migratori floristici da nord in direzione sud e da est in direzione ovest avvenuti nel corso di epoche geologiche passate. Anche nell'ambito della flora mediterranea censita si osservano relitti xerotermici migrati da sud verso nord durante le fasi interglaciali calde ed in altre ere geologiche. Le entità occidentali atlantiche e subatlantiche a loro volta rappresentano esempi di migrazioni floristiche da ovest verso est avvenute in coincidenza di climi umidi con distribuzione delle precipitazioni più uniformi durante le stagioni.

#### RINGRAZIAMENTI

Per aver fornito dati floristici si ringraziano: Aurelio Manzi, Daniele Di Santo e l'Ente Parco della Majella. Per aver consentito la consultazione di parti riguardanti le proprie tesi di laurea, si ringraziano Andrea Di Fabrizio e Massimo Di Francesco. Per aver inviato materiale bibliografico utile si ringraziano: Rosanna Caprara, Mitja Kaligarič, Giuseppe Tosi e le Biblioteche Provinciali di Chieti e Teramo. Per l'assistenza tecnica si ringraziano: Giovanni Galetti, Paolo Raiser e Bruno Vignini.

## PRVI POPIS FLORE OBČINE LAMA DEI PELIGNI (DEŽELA ABRUZZO IN NACIONALNI PARK MAJELLA)

Amelio PEZZETTA

I 34149 Trieste, Via Monteperalba 34, Italija

E-mail: fonterossi@libero.it

## POVZETEK

Ozemlje občine Lama dei Peligni zavzema približno 31 km<sup>2</sup>, leži pa na nadmorski višini 286 do 2690 m. Občina se nahaja v pokrajini Chieti (dežela Abruzzo) in je delno vključena v Nacionalni park Majella. Del njenega ozemlja predstavlja hribovito območje z različnimi vrstami litotipov, del pa gorsko območje, kjer prevladuje apnenčasto skalovje. V prispevku avtor podaja floristični seznam, ki vključuje 937 enot. Podatki so bili pridobljeni s terenskimi raziskavami in pregledom obstoječe literature. Avtor zaključuje, da na ozemlju, ki predstavlja približno 0,01 % površine Italije, domuje kar 12 % njene celotne flore, kar priča o visoki lokalni biotski raznovrstnosti. Seznam vključuje 339 taksonov sredozemske flore, 199 taksonov evrazijske in 180 taksonov evropske flore. Tekom raziskave je avtor zabeležil 207 novih taksonov in 75 endemitov.

**Ključne besede:** Lama dei Peligni, flora, Majella, Abruzzo, reka Aventino

## BIBLIOGRAFIA

**Abbate, E. (1903):** La flora. In: Guida d'Abruzzo. CAI, Roma, pp. 62-115.

**Blasi, C., R. Di Pietro & G. Pelino (2005):** The vegetation of alpine belt-karst-tectonic basins in the Central Apennines (Italy). *Plant Biosystems*, 139(3), 357-385.

**Caprara, R. (1986):** Lama dei Peligni nella storia e nella leggenda. Ed. Solfanelli, Chieti.

**Cesati, V. (1872):** Piante della Majella e della Morrone e delle loro adiacenze in Abruzzo citeriore, Ricordo ai cortesi visitatori del convegno aplinistico in Chieti nell'estate 1872. Stamperia della Regia Università, Napoli.

**Conti, F. & M. Pellegrini (1990):** Orchidee spontanee d'Abruzzo. Cogecstre Ed., Penne.

**Conti, F. & D. Tinti (2006):** Data base della flora vascolare del Parco Nazionale della Majella. Atti del convegno "La biodiversità vegetale nelle aree protette in Abruzzo: studi ed esperienze a confronto". Ente Parco Nazionale della Majella, Rocca S. Giovanni (Chieti), pp. 183-191.

**Conti, F. G. Abbate, A. Alessandrini & C. Blasi (eds.) (2005):** An annotated checklist of the Italian vascular flora. Palombi Ed., Roma, pp. 13-420.

**Daiss, H. & H. Daiss (1997):** Orchideen um die Majella (Abruzzen, Italien). *J. Eur. Orchideen*, 28(4), 603-640.

**Del Pizzo, G. (1999):** Lama dei Peligni, un microcosmo a misura d'uomo nel Parco della Majella tra passato e presente. Mario Janieri Ed., Casoli (Chieti).

**Di Fabrizio, A. (2006):** Vegetazione d'alta quota della Majella: ampliamento delle conoscenze nel settore sud orientale. Tesi di Laurea. Università Politecnica delle Marche, Facoltà di Agraria.

**Di Francesco, M. (2004):** Evoluzione del territorio nel Parco Nazionale della Majella-Morrone in ambito storico: attività antropiche e fuizione del manto boschivo nel Comune di Lama dei Peligni. Tesi di Laurea. Università degli Studi dell'Aquila.

**Di Pietro, R., P. Pelino, A. Stanisci & C. Blasi (2008):** Phytosociological features of *Adonis distorta* and *Trifolium noricum* subsp. *praetutianum*, two endemics on the Apennines (Peninsular Italy). *Acta Bot. Croat.*, 67(2), 175-200.

**Feoli Chiapella, L. (1979-80):** Contributo alla conoscenza della flora della Majella. *Delpinoa*, 21-22, 97-133.

**Fratraroli, A. R., G. Ciaschetti, L. Di Martino, G. Pirone, L. Del Monaco, T. Andrisano & M. Di Cecco (2006):** Ricerca sui cambiamenti floristici nella dinamica vegetazionale in un settore del Parco della Majella percorso da incendio nell'estate 2000. In: La biodiversità vegetale nelle aree protette in Abruzzo. Documenti tecnico-scientifici del Parco Nazionale della Majella, 3, pp. 210-224.

**GIROS (2009):** Orchidee d'Italia - guida alle orchidee spontanee. Il Castello, Cornaredo (Milano), 303 p.

**Gottschlich, G. (2009):** Die Gattung *Hieracium* L. (Compositae) in der Region Abruzzen (Italien). *Stapfia*, 89.

**Manzi, A. (1999):** Le piante alimentari in Abruzzo. Casa Editrice Tinari, Villamagna (Ch).

**Manzi, A. (2001):** Flora popolare d'Abruzzo. Ed. Rocco Carabba, Lanciano (Ch).

**Manzi, A. (2003):** Piante sacre e magiche d'Abruzzo. Ed. Rocco Carabba, Lanciano (Ch).

**Manzi, A. (2006):** Origini e storia delle piante coltivate in Abruzzo. Ed. Rocco Carabba, Lanciano (Ch).

**Peruzzi, L. (2010):** Checklist dei generi e delle famiglie della flora vascolare italiana. *Inform. Bot. Ital.*, 42(1), 151-170.

**Pezzetta, A. (1991):** Lama dei Peligni, il suo ambiente e la sua storia feudale e comunale. Ed. T. Bucci, Chieti.

**Pezzetta, A. (2010):** Gli elementi orientali Appennino-Balcanici, Illirici, Pontici e Sud-Est-Europei della flora italiana: origini e distribuzione geografica. *Annales, Ser. Hist. Nat.*, 20(1), 76-88.

**Pignatti, S. (1982):** Flora d'Italia, Vol. I-III. Edagricole, Bologna.

**Poldini, L. (1991):** Atlante corologico delle piante vascolari nel Friuli-Venezia Giulia. *Inventario floristico regionale*, Udine.

**Poldini, L. (2009):** La diversità vegetale del Carso fra Trieste e Gorizia: lo stato dell'ambiente. Ed. Goliardiche, Trieste.

**Tammaro, F. (1986):** Documenti per la conoscenza naturalistica della Majella: repertorio sistematico della flora. A cura del Centro di Servizi Culturali, Chieti.

**Tenore, M. (1832):** Relazione del viaggio fatto in alcuni luoghi di Abruzzo citeriore nella state del 1831. *Tipografia di Pasquale Tizzano*, Napoli.

**Ubaldi, D., W. Filz, G. De Santo & M. Di Cecco (1998):** Osservazioni sulla vegetazione della Riserva Majella Orientale. *Micologia e Vegetazione Mediterranea*, 13(2), 177-192.

**Villani, A. (1921):** Primo contributo allo studio della flora nella Provincia di Chieti. *Nuovo Giorn. Bot.*, 28, 69-111.



ZAVOD REPUBLIKE SLOVENIJE  
ZA VARSTVO NARAVE



### MedPAN North – 4. sestanek projektnega sveta, Izola, 19.-21. september 2011

Projekt MedPAN Nord, ki poteka v okviru Programa Med, je v veliki meri nadaljevanje uspešnega projekta MedPAN Interreg IIIC, ki je v letih 2004 do 2007 vzpostavil ustrezno omrežje in povezave med morskimi zavarovanimi območji v Sredozemlju. Vodilni partner projekta MedPAN Nord je WWF Francija, sicer pa v projektu sodeluje še 11 partnerjev iz šestih evropskih držav: Parc National de Port-Cros in ADENA iz Francije, grški Marine National Park of Zakynthos, Cinque Terre National Park, nevladna organizacija Federparchi in Marine Reserve of Miramare iz Italije, vladna Environment and Planning Authority z Malte, španski Junta de Andalusia, Generalitat de Catalunya z zavarovanima območjema Cabo de Creus ter Medes, sredozemski urad IUCN ter Zavod RS za varstvo narave.

Med pomembnimi cilji projekta MedPAN North velja omeniti predvsem aktivnosti v smeri povečanja učinkovitosti upravljanja morskih zavarovanih območij, ohranjanja biotske raznovrstnosti ter oblikovanja usmeritev za trajnostno načrtovanje posegov in aktivnosti v morju in na morskem obrežju. Skupni imenovalec vseh aktivnosti je usklajevanje pristopov posameznih partnerjev pri zagotavljanju uresničevanja širših mednarodnih, evropskih in nacionalnih obveznosti na področju oblikovanja omrežij morskih zavarovanih območij.

Celoten projekt je vreden 2,4 milijona evrov in je razdeljen v 5 sklopov – upravljanje s projektom, komuniciranje z javnostjo in deležniki, upravljanje z morskimi zavarovanimi območji ter trajnostno upravljanje ribolova in turističnega obiska. Udeležba Zavoda RS za varstvo narave v projektu temelji predvsem na naslednjih aktivnostih:

- na izdaji zgibanke o morskih habitatnih tipih Natura 2000 in obveščanju javnosti o poteku projekta,
- na oblikovanju ocene stanja kvalifikacijskih vrst in habitatnih tipov v morskem delu naravnega rezervata Strunjan ter oblikovanje priporočil za usmerjanje obiska območja s plovili,
- na sklenitvi okvirnega dogovora z ribiči v zvezi z izvajanjem gospodarskega ribolova na območju Naravnega rezervata Strunjan,
- na poskusni postavitvi priveznih mest na območju Naravnega spomenika Debeli rtič,
- na spremljanju obiska območja Naravnega spomenika Debeli rtič.

Četrty sestanek projektnega sveta je v organizaciji Zavoda RS za varstvo narave potekal od 19. do 21. septembra v Izoli. Sestanka so se udeležili vsi projektni

partnerji, preko nevladne organizacije Federparchi pa tudi več predstavnikov italijanskih morskih zavarovanih območij.

Osrednji del razprave je bil namenjen pregledu dosedanjih aktivnosti na posameznih delovnih sklopih projekta, ki se je začel izvajati julija 2010, ter uresničevanju zadanih organizacijskih in finančnih obveznosti. Udeleženci so tako razpravljali o ocenjevanju učinkovitosti upravljanja morskih zavarovanih območij, o tujerodnih in invazivnih vrstah ter o upravljanju s turističnim obiskom. Ob navedenih programskih sklopih pa je bila osrednja tema tokratnega projektnega sveta gospodarski ribolov v zavarovanih območjih, tudi v luči predvidene srečanja sredozemskih malih ribičev pomladi leta 2012 v Rimu.

Več informacij o projektu in projektnih aktivnostih je na voljo na spletni strani projekta [www.medpannorth.org](http://www.medpannorth.org).

**Robert Turk**

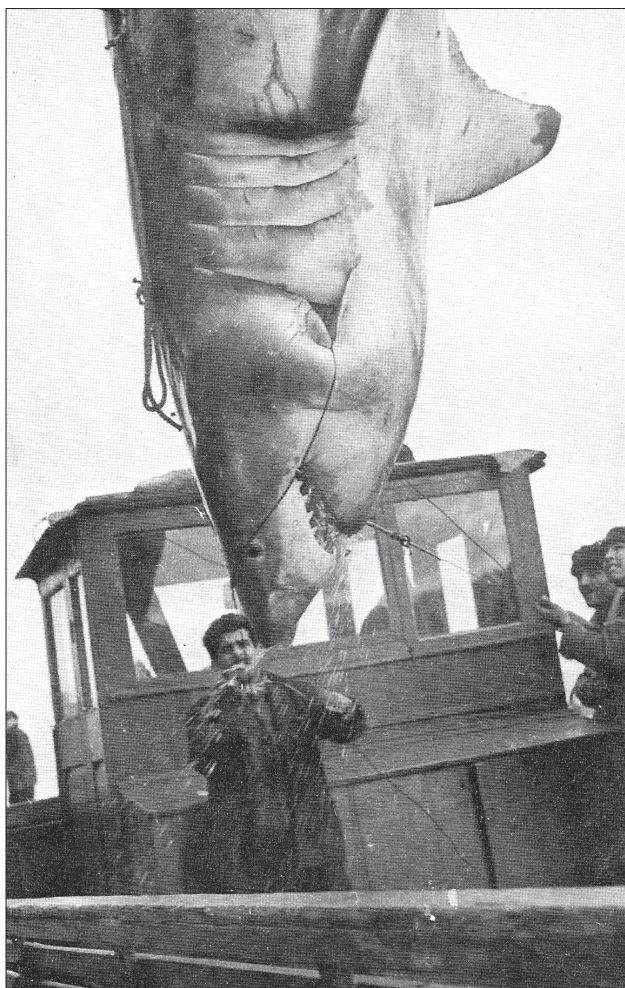
*“Man really need sea monsters in their personal oceans.”*  
The Log from the Sea of Cortez (John Steinbeck)

### GREAT WHITE TALES

With his weathered hands and wrinkled face, he seemed just like Hemingway's old fisherman. We met in the dining hall of the Samatya Fishing Port, situated on the European side of İstanbul city, where a couple of fishermen were playing cards while engaging in a heated debate on fishery regulations. Their faces were also full of wrinkles, but none of them as deep as the ones I saw on the face of the old fisherman, who was telling me the tales of the great whites of the Bosphorus Strait.

İrfan “Samatyalı” Yürür, now an 85-year-old fisherman, started fishing when he was seven, spent most of his life in the wake of the bluefin tuna (*Thunnus thynnus*), and sold his last boat in the late 1990s. After chasing the titans of the sea for more than half a century, he is now retired. During his active years, he was one of the prominent hand-liners of the Bosphorus, and reputed as “Samatyalı” İrfan. As for many others in pursuit of the bluefin tuna between the coasts of İstanbul, his struggle with the hooked giant of the depths was similar to the challenge of David and Goliath. The exact number of times he defeated the Bosphoric giants is still unclear, as he lost count of the number of bluefin tuna he had caught; however, the number of great white sharks (*Carcharodon carcharias*), accidentally hooked while waiting for the bluefin tuna, is still clear in his mind. “Between 1958 and 1960, I caught seven monsters” he said and added: “Once upon a time, the depths of the Bosphorus were a lair for the great whites.”

The beginning of the story of the Bosphoric great whites dates back to February 1881, when a huge speci-



**Fig. 1:** Great white shark, captured in 1967 off Büyüka-da, the Sea of Marmara; photograph of the specimen was published also in *Annales, Ser. Hist. Nat.*, 2008, 18(1), as Fig. 1. (Photo: IRS Archive)

**Sl. 1:** Veliki beli morski volk, ujet leta 1967 pri kraju Büyüka-da, Marmarsko morje; fotografija primerka je bila objavljena tudi v *Annales, Ser. Hist. Nat.*, 2008, 18(1), kot slika 1. (Foto: arhiv IRS).

men of 391 cm total length (TL) was stranded near Beylerbeyi coast in the southeastern part of the Bosphorus Strait. The Beylerbeyi specimen was the first recorded individual of *C. carcharias* from Turkish waters. Ten months later, another great white, a female of 470 cm TL, was hooked in the Bosphorus. The era of the great white shark off İstanbul coast lasted for almost a century.

With less than a dozen passionate volunteers, the Ichthyological Research Society (IRS), formed in 2000, brought fresh energy to shark research in Turkey. One of the primary aims of IRS was to determine the historical and contemporary status of large elasmobranchs in Bosphoric and prebosphoric waters of the Sea of Marmara. From the historical point of view, old records of great

white sharks, caught by tuna hand-liners off the İstanbul coast, were of particular concern. Currently, 29 great white sharks, caught in the mentioned marine area between 1881 and 1985, are recorded in the Great White Shark Data Bank of Turkey.

The occurrence of *C. carcharias* off İstanbul coast has always been headline news in several newspapers. One of these headlines, which appeared in *Milliyet*, a major daily newspaper of high circulation, on 28 December 1958, is noteworthy: Harbour Area Invaded by Sharks. The accompanying photograph of a 7 m long great white shark tied to a fishing boat is an important proof confirming the historical occurrence of *C. carcharias* in the Sea of Marmara. The content of the article, reporting on a provoked shark attack, is a remarkable detail underlining the aggressive interactions between old Bosphoric hand-liners and the hooked great whites.

The available data suggest that great white sharks used to be regularly although somewhat rarely captured in Bosphoric and prebosphoric waters of the Sea of Marmara between the late 1800s and the mid 1980s.



**Fig. 2:** İrfan "Samatyalı" Yürür still remembers the great whites which he caught in the Bosphorus Strait. (Photo: H. Kabasakal)

**Sl. 2:** İrfan "Samatyalı" Yürür se še vedno spominja velikih belih morskih volkov, ki jih je ujel v Bosporski ožini. (Foto: H. Kabasakal)

The seasonality of records shows an increase in their occurrence during winter months. Judging from the last confirmed record of this shark in Marmaric waters (in year 1985), the species was present in this sea until the last quarter of the 20th century. The occurrences as well as captures of great white sharks are closely associated with pelagic fishery, especially with hand-lining of the bluefin tuna. As “Samatyalı” İrfan stated several times during the interview, it was just a matter of luck a hooked bluefin tuna being seized by a great white shark. “We couldn’t see it; all we knew was that the monster was circling around the boat beneath the waves. When it seized the tuna, the blue water suddenly turned red and we could only get a big head on the hook.”

Years after, the memory of the great white shark, the so-called monster of the Bosphorus, is still clear in his mind.

The occurrence of *C. carcharias* in Marmaric waters was the consequence of its coexistence with the bluefin tuna. Lives of the titans of the sea were intertwined. However, bluefin tunas, one of the great white shark’s main preys, are known to have been absent from the Sea of Marmara since the late 1980s. Thus, hand-lining of this large pelagic bony fish in Marmaric and Bosphoric waters has been abandoned for at least 25 years. The available data suggest that great white sharks no longer occur in the Sea of Marmara. When the bluefin tuna became extinct in this sea, the great white shark followed it.

Today, *C. carcharias* seems to be extinct from the Sea of Marmara; however, recent studies show that the great white shark still occurs in Aegean waters of Turkey. In order to promote the survival of this vulnerable shark off the Turkish Aegean coasts, we should learn our lesson from the story of the extinction of the great white shark from Marmaric waters.

**Hakan Kabasakal & Özgür Kabasakal**  
Ichthyological Research Society, İstanbul, Turkey

#### AUGURI MIRAMARE



MINISTERO DELL’AMBIENTE  
E DELLA TUTELA DEL TERRITORIO E DEL MARE



Area Marina Protetta di Miramare  
Ente Gestore

Associazione italiana per il WWF for nature ONLUS



Venticinque anni fa un decreto istitutivo faceva nascere la Riserva Naturale Marina di Miramare. In realtà ben 13 anni prima un’associazione tra alcuni appassionati naturalisti ed un gruppo di attivisti del WWF locale creavano quella che sarebbe stata una delle prime riserve del Mediterraneo seguendo la nascita di Port-Cros in Francia. Nel 1986 quindi Miramare diventa una riserva

dello stato italiano, primo passo verso quello che la legge di tutela del mare definiva “Parco Marino del Golfo di Trieste”, rimasto ad oggi sulla carta.

Miramare quindi ancor oggi rimane uno dei pochi esempi italiani di gestione della costa e di studio di ambienti nei quali le attività vengono regolamentate e sviluppate con un impatto minimo e nella valorizzazione delle risorse biologiche.

Venticinque anni fanno pensare che oramai i bambini che per primi hanno frequentato le prime attività didattiche sono diventati gli adulti di oggi e, sebbene gli ultimi tempi non siano segnati da particolari trend positivi in fatto di rispetto dei beni ambientali, a giudicare dal continuo attacco insensato alle nostre aree naturali, al consumo delle risorse, rappresentano il risultato del messaggio che in questi anni è uscito dalle realtà come Miramare che via via sono nate nel golfo di Trieste. Assieme probabilmente hanno contribuito con le attività di conservazione a trasformarlo da messaggio astratto, magari patrimonio di pochi, in uno più concreto legato alla qualità della vita, e, a giudicare dalle frequentazioni di questi luoghi, dalle richieste di attività nuove da parte delle famiglie, ma anche dal trend in salita delle vacanze sempre più contornate di natura, il messaggio lasciato nelle bottiglie di 25 anni fa è giunto alla sua destinazione alle nuove famiglie di 25 anni dopo. Quindi, forse, meglio delle previsioni: un ambiente che esce dalle riserve, dalle oasi, dai parchi e diviene uno strumento dell’uomo per vivere meglio la sua vita. Un ambiente che non è lo zoo da andare a visitare lasciando tutto il resto allo sviluppo smodato, ma una continua richiesta di averlo anche nelle città, nel lavoro etc... Le aree come quella di Miramare (così vicina alla città), diventano quindi delle zone in cui sperimentare nuove (nuove?) modalità di visita e di approccio con la natura, di collegamento con le aree urbane, di visita nei luoghi di vacanza, nei luoghi di svago. In 25 anni le aree come Miramare hanno contribuito a veicolare una sempre più alta pressione antropica, spesso inconsapevole dell’effetto devastante che può provocare alla fragilità di certe zone così delicate e ricche di natura nello stesso tempo. La nascita di Miramare è coincisa con l’esplosione del turismo internazionale, il boom della subacquea e dei luoghi un tempo incontaminati. Da sempre Miramare ha voluto sperimentare modalità di visita legate ad impatti sempre meno pesanti: quanti subacquei possono percorrere lo stesso itinerario senza distruggerlo? Quale addestramento devono avere le guide? Quali organismi sono i più vulnerabili e devono essere protetti? Sono state le principali domande che ci hanno permesso tra l’altro di organizzare visite subacquee in zona A, definita area integrale. Visita quindi consentita, ma con accompagnatori addestrati ad orientare l’itinerario verso zone meno vulnerabili in caso di comportamenti impattanti da parte del gruppo. Miramare ha assistito a cambiamenti epocali: da un’immersione dedicata alla caccia subacquea come avveniva nei primi anni ‘80, a quella

per scattare una buona foto, girare un video, appassionarsi ai corsi di biologia marina. Poi a un'immersione fatta da perfetti subacquei con autorespiratore vestiti di tutto punto si è passati ad entusiasti seawatchers con pinne, mutino e maschera, spesso con macchina digitale, spesso accompagnati da figli o ancora più spesso figli che portavano genitori. Da rare, rarissime immersioni in seawatching durante le settimane estive, si è passati a corsetti per ragazzi. Attività in trasformazione che in pochi anni hanno diversificato il numero delle presenze: da una maggioranza di subacquei in gruppi (1500 sub, 200 seawatching) si è passati ad una prevalenza di seawatchers (500 sub, 1800 seawatching), quindi di esploratori anche di altri luoghi di vacanze con pinne e maschere.

Miramare però è anche una riserva che ha proposto nuove modalità per affrontare le classiche conflittualità tra conservazione e sfruttamento delle risorse: il problema della pesca professionale ha visto per la prima volta forse il pescatore come una specie in via di estinzione assieme ad una pesca svolta a ridosso dei confini (se non all'interno) che con l'uso delle lampare ad esempio, provocava grossi problemi anche alle specie non commerciali. Situazioni sgradevoli in quanto le specie pescate non si trovavano attorno al promontorio, ma decine di imbarcazioni da pesca a ridosso dei confini illuminati tutta la notte provocavano l'uscita ed il disturbo di quelle residenti. Il problema è stato eliminato con la creazione di una zona buffer con ordinanza della Capitaneria di Porto che si è andata a sommare alla tutela del decreto. La pesca non veniva abolita, ma regolamentata mediante modalità di turnazione, limiti alle calate e controllo del pescato, prevalentemente la Mormora. Con questa importante aggiunta, Miramare nel 1995 passava dai 30 ettari a 120 ettari di acqua protetta attorno al Promontorio, con le lampare finalmente al di fuori dell'area protetta avendo tra l'altro, imparato dal biologo a bordo che i pesci arrivavano da fuori nella zona di Miramare e che in certe stagioni bastava aspettarle al largo prima che giungessero nell'area. Pescatori che imparano a gestire in maniera nuova una risorsa, una risorsa di tutti che va mantenuta tale. In questi 25 anni quindi probabilmente capiscono che non sono gli unici che dipendono dalle risorse marine, e che ci sono anche altri professionisti che dipendono dalla stessa risorsa, che vivono peraltro senza distruggerla.

A Miramare le risorse biologiche sono un patrimonio che attira turisti: il biglietto e le peculiarità vengono costantemente monitorate e quantificate. Se ad esempio un pescatore irresponsabile catturasse le corvine (*Corvina nigra*) presenti lungo l'itinerario subacqueo, avrebbe guadagnato 300-350 € (una tantum). Per Miramare considerando chi viene a vederle e fotografarle, si parla di 6000 €/anno (ogni anno) solo come percentuale di preferenza nei turisti subacquei paganti. In 25 anni fanno 150.000 € di contributo che questa specie dà alla sua stessa tutela! Non è scorretto parlare in natura anche

di economia, uno dei progressi forse in 25 anni è stato quello di rendere la conservazione più vicina ai problemi e alle necessità di un territorio: non più come fine ultimo una conservazione arrabbiata con uno sviluppo stupido e fuori tempo (che fortunatamente rimane nella nostra cultura), ma una obiettiva contrapposizione ed esposizione di alternative nel turismo, nella valorizzazione delle attrattive che creano nuove economie, nella pesca che valorizza il prodotto, nella ricerca scientifica fuori dai laboratori e con tempistiche adeguate alle domande di chi amministra il territorio. In questo ha trovato una forte corrispondenza con il NIB - Stazione di Biologia Marina di Pirano e le sue attività di monitoraggio con cui vengono seguite le dinamiche delle risorse biologiche marine, in particolare in un unico sistema che include oltre a Miramare le riserve gemellate di Strunjan e Punta Madonna. O ancora OGS - Oceanografia chimica fisica biologica di Aurisina, ideale continuazione del lavoro e delle attività scientifiche della Stazione Zoologica di Trieste, nata ancora sotto l'impero Austro-Ungarico alla quale anche i ricercatori di Miramare fanno riferimento ed interessanti confronti. In un quarto di secolo, così come avvenuto spesso in queste zone, i confini di terra hanno cercato di confondere quello che avveniva in mare. Infatti, le risorse del mare non vedono i limiti dell'uomo sia che si tratti dei confini delle aree protette sia degli stati nazionali. I limiti li mettono la natura ed i cambiamenti che indubbiamente in questo periodo si sono verificati. Ad esempio il calo delle specie "più fredde" come *Fucus virsoides* alga bruna ricordata per il tallo vescicoloso che un tempo caratterizzava questo mare come il più "atlantico" ed aumento graduale delle specie "calde" che con frequenza crescente sono entrate nel golfo di Trieste ed ora lo rendono lentamente più Mediterraneo di un tempo. Venticinque anni che permetterebbero dei bilanci soddisfacenti soltanto a considerare la compagine (anche lavorativa) che ha deciso di crescere, condividere e dedicare la vita professionale a questa strana attività. Va detto che un quarto di secolo fa questo non esisteva ed ora si può anche apprezzare una certa continuità, almeno nelle risposte delle nuove leve, sebbene l'incertezza finanziaria e le convinzioni delle amministrazioni riescano sempre a riportare all'imponderabile dei primi anni in una sorta di non voluto processo di ringiovanimento, almeno negli stati d'animo. Ma va bene così, anche se potrebbe andare meglio!

Tanti auguri Miramare, sperando di non vederti invecchiare noiosa e brontolona con lo sguardo indietro nel tuo ormai onorevole passato in una imitazione e ripetizione di te stessa. Meglio vederti in giro per il Mediterraneo a riprodurti e riconoscerti giovane in tante piccole realtà ed attività, ancora meglio fuori dai confini delle aree marine protette nella vita e negli ambienti di tutti i giorni.

**Roberto Odorico**

Jakov Dulčić & Branko Dragičević: NOVE RIBE JADRANSKOG I SREDOZEMNOG MORA. Institut za oceanografiju i ribarstvo, Split & Državni zavod za varstvo prirode, Zagreb, 2011.



Biološka raznovrstnost se danes sooča z hudimi problemi, ki domala dnevno siromašijo zakladnico živih bitij na planetu Zemlja. Če smo še pred dobrim desetletjem mislili, da so onesnaževanje okolja, degradacija in izguba življenjskih okolij in netrajnostno izkoriščanje naravnih virov glavni krivci za krizo biodiverzitete, sta danes v takšni meri, če ne še večji, poleg treh omenjenih prisotna še dva, in sicer globalne podnebne spremembe in bioinvazija. Paradoksalno je, da se o problemu bioinvazije podrobneje seznanjamo šele danes, pozabljajoč, da se je vse v bistvu pričelo že s Kolumbom, najverjetneje pa še prej. Bioinvazija predstavlja širjenje tujerodnih vrst na tak ali drugačen način. V morju je teh načinov zelo veliko, od razne obrasti na plovilih, balastnih voda in sedimentov v plovilih, do vnosa tujih vrst z marikulturo, nespretnega rokovanja z akvariji in še kaj. Še pred kratkim so bili strokovnjaki mnenja, da se vsako leto v Sredozemskem morju naseli 10 tujerodnih vrst, po najnovejših ocenah pa celo 1 vrsta vsakih 10 dni. Danes vemo, da je širjenje tujerodnih vrst po svetu velik problem, ki ima v več primerih ne samo hude eko-

loške ampak tudi ekonomske posledice; spomnimo se npr. problemov s tujerodno rebračo v Črnem morju, ki je hudo osiromašila črnomorski ribolov.

Navzlic hudim problemom, ki so posledica prihoda nekaterih tujerodnih organizmov v novo okolje, je ne navadno, kako malo strokovne literature obravnava to tematiko. Zato je znanstvena monografija prof. Dulčića, ki je eden izmed pionirjev v raziskovanju bioinvazije v Jadranskem morju, in njegovega mladega raziskovalca Branka Dragičevića dobrodošla osvežitev na tem področju. Oba prihajata z Inštituta za ribištvo in oceanografijo iz Splita, ki je tudi soizdajatelj obravnavane monografije. Avtorja pišeta o novih ribah v Jadranskem in Sredozemskem morju, ki so v novo okolje prišle kot tujerodne vrste ali pa so spričo podnebnih sprememb povečale svoje območje razširjenosti proti severu, vključila pa sta tudi nekaj vrst, ki so bile doslej prezrte ali zelo slabo poznane.

Monografija obsega 160 strani in je strukturno razdeljena v 11 poglavij, od katerih so seveda najpomembnejša tista, ki govorijo o novih ribah v Jadranskem morju, o novih ribah v Sredozemskem morju in o novih ribah, ki že čakajo na vходу v Jadransko morje, kjer za zdaj še niso bile zabeležene. Ta poglavja predstavljajo jedro monografije, saj je v njih predstavljena sleherna vrsta, ki je bila doslej zabeležena v Jadranskem ali Sredozemskem morju. Opis zajema fotografijo vrste, osnovno nomenklaturo, meristične podatke, obširnejši opis vrste ter zbir podatkov o biologiji, življenjskem okolju, razširjenosti, statusu v Jadranskem morju in socio-ekonomskem pomenu vrste danes. Poleg omenjenega sta avtorja za vsako vrsto priložila tudi zemljevid z lokalitetami, kjer je bila le-ta zabeležena. Avtorja tako obravnavata 46 vrst, ki so bile prvič zabeležene za Jadransko morje, dodatnih 44 vrst, ki so bile po letu 2002 prvič opažene v Sredozemskem morju, ter še 4 vrste, ki jih lahko v kratkem upravičeno pričakujemo v Jadranu. Ker se avtorja zavedata pomena ažurnega informiranja o vsaki nenavadni vrsti, sta na konec monografije dodala še nekakšen obrazec za podatke, s katerimi je potrebno opremiti morebitno najdbo.

Knjigo krasi izvirna in lično oblikovana naslovnica, ki me spominja na tlak, prepreden z mozaiki kakšne bazilike, poslikan z nenavadnimi tujerodnimi ribami. Tudi sicer je format knjige privlačen, notranja oblika pa nad vse praktična. Res je, da niso vse fotografije tujerodnih in drugih vrst vzorne, saj sta avtorja vztrajala, da so v knjigi primerki rib, ki so bili opisani v znanstvenih prispevkih o prvem pojavu dotične vrste v Jadranu in/ali Sredozemskem morju. Avtorjema zato iskreno čestitam k izdaji pregleda tujerodne ihtiofavne na takšen način. Menim, da je edina pomanjkljivost te knjige, če se temu lahko sploh tako reče, le ta, da jo bo potrebno čez kakšno desetletje ali še prej dopolnjeno ponovno izdati, saj je tujerodnih prišlekov v Sredozemsko morje vsako leto več, tudi med ribami.

**Lovrenc Lipej**